Configuring the Cisco uBR900 Series Cable Access Routers

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Feature Overview

Cisco uBR900 series cable access routers are fully-functional Cisco IOS routers and standards-based bidirectional cable modems that give a residential or small office/home office (SOHO) subscriber high-speed Internet or Intranet access and packet telephone services via a shared two-way cable system and IP backbone network. Cisco uBR900 series cable access routers are based on the current Data-Over-Cable Service Interface Specifications (DOCSIS) standards, and interoperate with any bidirectional, DOCSIS-qualified headend cable modem termination system (CMTS).

Cisco uBR900 series routers connect computers, telephone equipment, and other customer premises devices at a subscriber site to the service provider's Hybrid/Fiber Coax (HFC) and IP backbone network. Functioning as cable modems, the Cisco uBR900 series routers transport data and voice traffic on the same cable system that delivers broadcast TV signals.

Cisco uBR900 series cable access routers typically ship from the Cisco factory with a Cisco Internetwork Operating System (IOS) software image stored in nonvolatile memory (NVRAM). The standard Cisco IOS software image supports DOCSIS-compliant bridging operation for data as the default.

Based on the feature licenses purchased, other Cisco IOS images can be downloaded from Cisco Connection Online (CCO). Each Cisco uBR900 series router in your network can then be configured to support Voice over IP (VoIP) and/or other special operating modes based on your service offering and the practices in place for your network. A Cisco uBR900 series device can function as an advanced router, providing wide area network (WAN) data connectivity in a variety of configurations.

Cisco IOS Software Feature Sets

This section briefly describes the common feature sets supported by the Cisco uBR900 series cable access routers. Each feature set contains a number of features that provide a specific functionality such as Voice over IP (VoIP) or virtual private network (VPN) access.

The following feature set categories are currently available:

- Data Operations
- Data and Voice Operations

The data and voice feature sets add Voice over IP (VoIP) support to the same base features contained in the data only feature sets. Telephones that are connected to the uBR924 cable access router can make voice calls over the Internet using either the H.323 (Gateway/Gatekeeper) voice control protocol or Simple Gateway Control Protocol (SGCP). (For more information on these protocols, refer to H.323 Protocol Stack and SGCP Protocol Stack in this document.)

Because voice calls are real-time traffic, the Cisco uBR924 cable access router supports the DOCSIS Quality of Service (QoS) enhancements to give higher priority to IP packets containing voice traffic.

Note Voice features are available only on the Cisco uBR924 cable access router.

Note Feature sets and software images vary depending on the cable access router model you are using and the Cisco IOS software release that is running. For a list of the available software images for your application, and the specific features contained in each image, refer to the release notes for the Cisco uBR900 series cable access router and Cisco IOS software release you are using. This document describes the features available for the Cisco uBR904 and uBR924 cable access routers in Cisco IOS Release 12.0(7)T.

The following feature sets are available in data and voice versions as well as in data only versions:

- Base IP Bridging – provides full DOCSIS 1.0-compliant cable modem support for users who want a basic high-speed connection to the Internet.
- Home Office (Easy IP) – provides a high-speed connection to the Internet, along with server functions that simplify the administration of IP addresses, so that the Cisco uBR900 series cable access router can connect a small number of computers to the Internet through the cable interface.
- Small Office – provides a firewall feature set in addition to the high-speed Internet connection and server functions provided by the Home Office feature set. You can protect your office network from intrusion and interference while still having high-speed access to the Internet.
- Telecommuter – provides encryption and layer 2 tunneling support in addition to the high-speed Internet connection and server functions provided by the Home Office feature set. Businesses can establish secure high-speed Internet connections between employees' homes and the office local network.

These feature sets are described in the following sections.

Base IP Bridging

Base IP Bridging includes full and DOCSIS-compliant bridging and DOCSIS Baseline Privacy. The Base IP Bridging feature set allows the Cisco uBR900 series cable access router to function as a DOCSIS 1.0 cable modem and to interoperate with any DOCSIS 1.0-qualified CMTS. It provides basic high-speed Internet connectivity for users who want to connect only one computer to the cable network.

DOCSIS-compliant bridging (also referred to as “plug-and-play” bridging) is the default configuration for Cisco uBR900 series cable access routers. While in plug-and-play bridging mode, the router locates a downstream and upstream channel; finds ToD, TFTP, and DHCP servers; obtains an IP address; downloads a DOCSIS configuration file; and obtains DHCP parameters to work in bridging mode.

Note This feature set does not include Easy IP and Routing.

In DOCSIS-compliant bridging mode, the Cisco uBR900 series cable access router acts as a transparent bridge for the following device combinations:

- 3 CPE devices when using Cisco IOS Release 12.0(4) XI1 or higher
- 254 CPE devices when using Cisco IOS Release 12.0(5)T or higher images, or Cisco IOS Release 12.1.

Note The ability of the Cisco uBR900 series cable access router to grant access to CPE devices is controlled by the MAX CPE field in the DOCSIS configuration file. The MAX CPE field defaults to one CPE device unless otherwise set to a higher number.

Home Office (Easy IP)

The Home Office feature set provides high-speed Internet connectivity for customers who have a small home network (typically 2-4 computers). In addition to full DOCSIS 1.0 support and all of the functionality of the Base IP Bridging feature set, the Home Office feature set (also known as Easy IP) supports intelligent Dynamic Host Configuration Protocol (DHCP) server functions, including DHCP Relay Agent and DHCP Client functionality. It also supports Easy IP (NAT/PAT).

This feature set allows the Cisco uBR900 series cable access router great flexibility in administering IP addresses for the PCs and other customer premises equipment it is connecting to the cable network. The DHCP functionality allows intelligent use of the IP addresses that allow customer premises computers and other equipment to connect to the Internet. The NAT/PAT functionality allows you to use private IP addresses on the local network, while still maintaining connectivity to the Internet.

Small Office

In addition to full DOCSIS 1.0 support and all of the functionality of the Easy IP feature set, the Small Office feature set supports the Cisco IOS firewall feature set which provides a wide range of security features for Cisco uBR900 series cable access routers. Using the firewall feature set, Cisco uBR900 series cable access routers act as buffers between the customer’s private enterprise network and the Internet and other connected public networks.

In firewall mode, the Cisco uBR900 series cable access router provides a high-speed Internet connection for an office's local network while protecting the computers on the office network from common attacks such as denial of service attacks and destructive Java applets, as well as real-time alerts of such attacks.

The Small Office feature set can be optionally extended with support for IPSec encryption to ensure that the traffic passed over the Internet cannot be intercepted. You can select either standard 56-bit IPSec Network Security encryption or high-security 168-bit Triple Data Encryption Standard (DES) encryption.

Telecommuter

In addition to full DOCSIS 1.0 support and all of the functionality of the Easy IP feature set, the Telecommuter feature set supports IPSec encryption and the Layer 2 Tunneling Protocol (L2TP), which can establish secure high-speed Internet connections between employees' homes and the office local network.

IPSec is an IP security feature that provides robust authentications and encryption of IP packets for the secure transmission of sensitive information over unprotected networks such as the Internet. You can select either standard 56-bit IPSec Network Security encryption or high-security 168-bit Triple Data Encryption Standard (DES) encryption.

L2TP is an extension of the Point-to-Point Protocol (PPP) that allows computers on different physical networks to interoperate as if they were on the same local area network (LAN). These features are important components for Virtual Private Networks (VPNs).

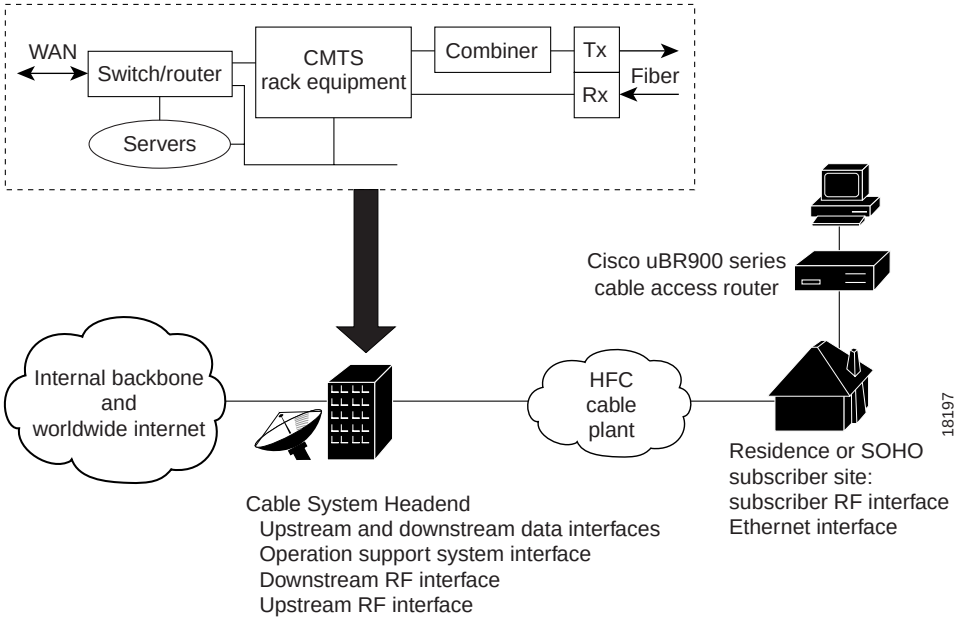
Note The Telecommuter feature set does not require the firewall feature set because the individual telecommuter has a secure connection to the office network. The office network, however, should implement a firewall for its own connection to the Internet.

Data Operations

Figure 1 illustrates a typical broadband data cable system. Data transmitted to a Cisco uBR900 series cable access router from the service provider's CMTS shares a 27 or 26 Mbps, 6 MHz data channel in the 88 to 860 MHz range. The Cisco uBR900 series cable access router shares an upstream data rate of up to 10 Mbps on a 200 kHz-wide to 3.2 MHz-wide channel in the 5 to 42 MHz range.

Note End-to-end throughput varies based on the design and loading of network components, the mix of traffic, the processing speed and interface of the host server(s), the processing speed and local Ethernet performance of the subscriber's computer, as well as other parameters. Since the network can be configured to support multiple levels of service to meet differing market price/performance requirements, the subscriber's service level agreement also affects throughput. DOCSIS further contains some fundamental performance limitations because standards are designed to give a larger number of customers good performance, rather than permitting a few users to consume the entire capacity.

Figure 1 Typical Cisco Broadband Data Cable System



Operating Modes

The broadband data cable system uses multiple types of access control to ensure efficient use of bandwidth over a wide range of loading conditions. Advanced queuing techniques and service algorithms are used to define the acquisition and release of channels.

Cisco uBR900 series cable access routers support 64 or 256 Quadrature Amplitude Modulation (QAM) downstream, and Quadrature Phase Shift Keying (QPSK) or 16 QAM upstream transmission. This allows the CMTS system administrator to set the preferred modulation scheme based on the quality of the cable plant.

Note In noisy plant environments, 16 QAM upstream and 256 QAM downstream modulation may not be viable. In high-quality HFC networks capable of supporting 16 QAM formats in the upstream direction, Cisco recommends using QPSK for fixed-slot short packets like maintenance or data requests, and 16 QAM for variable length data packets. This results in the most efficient use of the available upstream timeslots or minislots.

The system uses Transmission Control Protocol/Internet Protocol (TCP/IP) to transmit data. TCP/IP transmits data in segments encased in IP datagrams, along with checksums to detect data corruption and sequence numbers to ensure an ordered byte stream on the TCP connection between the Cisco cable access router and the CMTS.

Cisco cable access routers also support multicast services—data streams sent to groups of subscribers. These applications utilize the User Datagram Protocol (UDP) instead of TCP. Since UDP does not mandate upstream acknowledgments, these applications can be very efficient in the network. Additionally, restricting upstream throughput will have no effect on downstream UDP streaming throughput.

Note Interactive games are the exception. Although low latency is required in gaming applications, high upstream data throughput is not demanded since the volume of data transmitted upstream is typically small.

Data Specifications

Table 1 Cisco uBR900 Series Cable Access Router Data Specifications

Description	Downstream Values	Upstream Values
Frequency Range	88 to 860 MHz	5 to 42 MHz
Modulation	64 QAM 256 QAM	QPSK 16 QAM
Data Rate	30 Mbps/64 QAM (27 Mbit/sec after FEC overhead) 42.8 Mbps/256 QAM (36 Mbit/sec after FEC overhead)	QPSK—320 Kbit/sec to 5 Mbit/sec 16 QAM—640 Kbit/sec to 10 Mbit/sec
Bandwidth	6 MHz	200K, 400K, 800K, 1.6M, 3.2 MHz
FEC	RS (122, 128) Trellis	Reed Solomon
One Channel	Receive level of digital signal -15 to +15 dBmV **Note** Most field measurements are of nearby or adjacent analog signal which is normally +6 to +10 dB (system specific) above the digital signal level	QPSK— +8 to +58 dBmV 16 QAM— +8 to +55 dBmV
Signal-to-Noise Ratio (SNR)	64 QAM: >23.5 dB @ BER<10^8 256 QAM*: >30 dB @ BER <10^-8 (For input level between +15 and -8 dBmV, SNR must be greater than 30 dB. For input level between -8 and -15 dBmV, SNR must be greater than 33 dB.) **Note** These performance numbers are in laboratory-controlled conditions against statistically pure noise sources (AWGN). Since such conditions do not exist in practise, a 6 dB or more SNR margin is required for reliable operation. Check with your local system guidelines.	QPSK: >15 dB @ BER<10^-8 (QPSK will work at 98% successful ping rate for SNR>13 dB. A SNR of 15 dB will be needed to get almost optimal packets per minute transition.) 16 QAM: >22 dB @ BER <10^-8 (For 16 QAM, a SNR>22 dB makes the grade for 98% ping efficiency. To get good packet rate, you need SNR>25 dB) **Note** These measurements were made for 0 and -10 dBmV input to the CMTS, 1280 ksym/sec and 64 bytes packet size with a Cisco uBR904 cable access router and laboratory-controlled conditions.

Table 1 Cisco uBR900 Series Cable Access Router Data Specifications (continued)

Description	Downstream Values	Upstream Values
Security	DES decryption: DOCSIS Baseline Privacy (BPI), 40 bit-, 56 bit- and 168 bit DES encryption, as controlled by the headend and configuration files. **Note** Cisco IOS images must contain encryption software at both the CMTS and the Cisco uBR900 series. Both routers must be enabled and properly configured to support encryption.	DES encryption

Service Assignments

Each Cisco uBR900 series cable access router on the network is configured to receive data on a particular downstream channel. A downstream channel contains upstream segment(s). Each upstream segment typically serves more than one fiber node.

Partitioning the upstream plant into smaller segments significantly reduces the number of potential ingress sources and failure points. The CMTS divides the cable plant into downstream channels and upstream segments or clusters of nodes.

Downstream and Upstream Data Transfer

When operating normally, the Cisco uBR900 series cable access router receives data addressed to it from the CMTS. The router reads the address in the header of the message, filters the message and forwards it to the appropriate device at the subscriber site.

Note Bandwidth at the subscriber site is shared by the active data users connected to the network segment.

For upstream data transfer, the Cisco cable access router uses a request/grant mechanism to obtain upstream bandwidth. The CMTS configures, via MAC messages, upstream parameters associated with transmissions from all Cisco cable access routers on the system. Service class registration is granted based on class assignment and load provisioning. Upstream channels are time slotted and divided into basic scheduling time units.

The CMTS informs the Cisco cable access router of minislot structures on the upstream channel. Some minislots are marked as contention-based—shared by routers to make bandwidth (timeslot) requests with the CMTS. Others are grouped together into unicast grants for specific routers to send their data bursts. Yet others are grouped together into maintenance slots for “keep alive” messages from routers to the CMTS.

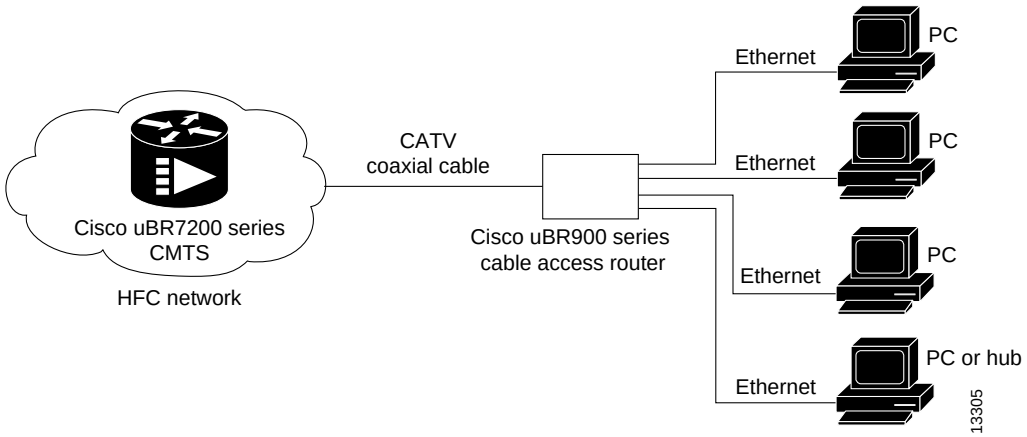
Bridging Applications

In bridging applications, the Cisco uBR900 series cable access router acts as a transparent bridge for up to 254 devices depending on the version of Cisco IOS software you are using. Older versions of software allow a maximum of 3 CPE devices to be bridged. The cable access router is connected to the Internet through the coaxial cable interface. All four 10BaseT Ethernet ports are treated as one Ethernet interface by the Cisco IOS software. The IP addresses for the CPE devices and the coaxial cable interface are typically in the same subnet, although this is not a requirement.

The Cisco uBR900 series complies with the DOCSIS standards for interoperable cable access routers; it supports full transparent bridging as well as DOCSIS-compliant transparent bridging.

Note If the attached CPE devices and the coaxial cable interface are in different IP subnets, the cable interface must have a secondary address.

Figure 2 Cisco uBR900 Series Cable Access Router in a Bridging Configuration



DOCSIS-compliant transparent bridging is the factory default configuration of the Cisco uBR900 series cable access router. If your cable service provider is using a DHCP server, all you need to do is connect the cables and power on the cable access router; your service provider's configuration program will automatically configure both the coaxial cable interface and the bridging functionality. You do not need to set up IP addresses for the attached PCs or enter any Command Line Interface (CLI) configuration commands. This type of operation is called plug-and-play bridging.

In DOCSIS-compliant bridging mode, the cable access router is able to locate a downstream and upstream channel; find the TOD, TFTP, and DHCP server(s); obtain an IP address; download a DOCSIS configuration file; and obtain DHCP parameters to work in a bridging mode.

You can configure a customized bridging application on the Cisco uBR900 series using a downloadable configuration file or the CLI. See the sections "Configuring Bridging" on page 41 and "Customizing the Cable Access Router Interface" on page 44 for details.

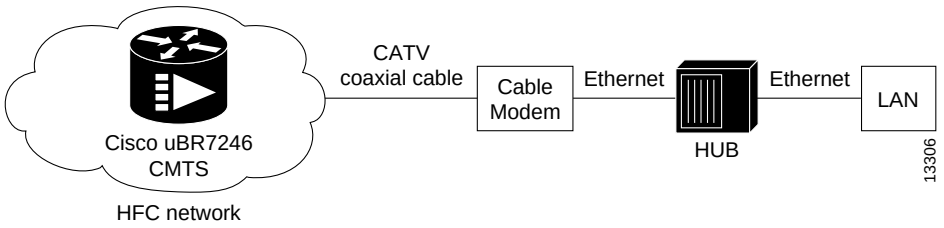
Routing Applications

The Cisco uBR900 series cable access router can be configured to act as a router to preserve IP address space and limit broadcasts that can impact the performance of the network. A typical use would be if you are connecting the cable access router to an internal Ethernet hub that is connected to an existing PC network. The Cisco uBR900 series supports Routing Information Protocol Version 2 (RIP V2) for this application.

When configured in routing mode, the Cisco uBR900 series is automatically configured to use the headend's IP address as its IP default gateway. This allows the cable access router to send packets not intended for the Ethernet interface to the headend when IP host-routing is configured.

RIP V2 routing is useful for small internetworks in that it enables optimization of Network Interface Center (NIC)-assigned IP addresses by defining variable-length subnet masks (VLSMs) for network addresses, and it allows classless interdomain routing (CIDR) addressing schema.

Figure 3 Cisco uBR900 Series Cable Access Router in a Routing Configuration with a Hub



Layer 2 Tunneling Protocol

Layer 2 Tunneling Protocol (L2TP) is an emerging Internet Engineering Task Force (IETF) standard that combines the best features of two existing tunneling protocols: Cisco's Layer 2 Forwarding (L2F) and Microsoft's Point-to-Point Tunneling Protocol (PPTP). L2TP is an extension of the Point-to-Point Protocol (PPP), which is an important component for Access Virtual Private Networks (VPNs).

Traditional dial-up networking services only supported registered IP addresses, which limited the types of applications that could be implemented over VPNs. L2TP supports multiple protocols and unregistered and privately administered IP addresses over the Internet. This allows the existing access infrastructure such as the Internet, modems, access servers, and ISDN terminal adapters (TAs) to be used.

L2TP can be initiated wherever PPTP or L2F is currently deployed, and can be operated as a client initiated tunnel such as PPTP, or a network access server (NAS) initiated tunnel such as L2F.

The current implementation of L2TP in Cisco IOS software is dependent on a PPP connection supported on one of the directly attached interfaces. A dial-up PPP connection is required in order to initiate an L2TP Tunnel connection. This is a requirement of the L2TP Access Concentrator (LAC). Currently the Cisco uBR900 series cable access router cannot function as the LAC; it can only function as the L2TP Network Server (LNS), which terminates a tunnel created elsewhere in the network.

Easy IP

Dynamic Host Configuration Protocol (DHCP) Server

Cisco uBR900 series cable access routers support Intelligent DHCP Relay and DHCP Client functionality. A DHCP Relay Agent is any host that forwards DHCP packets between clients and servers. A DHCP Relay Agent enables the client and server to reside on separate subnets. If the Cisco IOS DHCP server cannot satisfy a DHCP request from its own database, it can forward the DHCP request to one or more secondary DHCP servers defined by the network administrator using standard Cisco IOS IP helper-address functionality.

Network Address Translation and Port Address Translation (NAT/PAT)

Network Address Translation (NAT) reduces the need for globally unique IP addresses. NAT allows an organization with addresses that are not globally unique to connect to the Internet by translating those addresses into globally routable address space.

Port Address Translation (PAT) is a similar mechanism that enables all internal hosts to share a single registered IP address (many-to-one translation). NAT/PAT:

- Allows customers to maintain their own private networks while giving them full Internet access through the use of one or more global IP addresses
- Allows several private IP addresses to use the same global IP address by using address overloading
- Facilitates configuration and permits a large network of users to reach the network by using one Cisco uBR900 series cable access router and the same DOCSIS cable interface IP address
- Eliminates the need to readdress all hosts with existing private network addresses (one-to-one translation) or by enabling all internal hosts to share a single registered IP address (many-to-one translation, also known as Port Address Translation [PAT])
- Enables packets to be routed correctly to and from the outside world by using the Cisco uBR900 series cable access router
- Allows personal computers on the Ethernet interface to have IP addresses to be mapped to the cable interface's IP address

Routing protocols will run on the Ethernet interface instead of the cable interface, and all packets received are translated to the correct private network IP address and routed out the Ethernet interface. This eliminates the need to run RIP on the cable interface.

To implement NAT on the Cisco uBR900 series, the Ethernet interface is configured with an "inside" address and the cable interface is configured with an "outside" address. The Cisco uBR900 series also supports configuration of static connections, dynamic connections, and address pools.

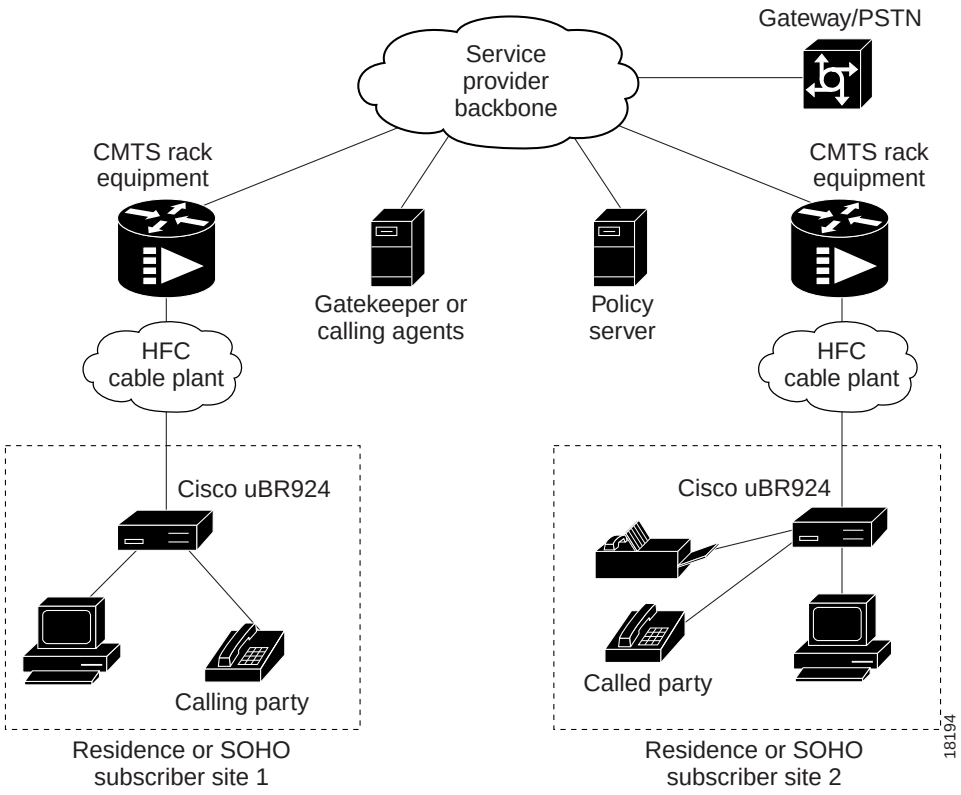
Voice Over IP Operations

Note Voice features are available only on the Cisco uBR924 cable access router.

The Cisco uBR924 cable access router uses packets to transmit and receive digitized voice over an IP network. Voice signals are packetized and transported in compliance with H.323 or Simple Gateway Control Protocol (SGCP). H.323 is an International Telecommunications Union (ITU) standard that specifies call signaling and control protocols for a shared IP data network. SGCP is a Cisco/Bellcore-developed, out-of-band signaling protocol under review by the Internet Engineering Task Force (IETF).

Figure 4 illustrates a broadband cable system that supports VoIP transmission. Quality of Service (QoS) and prioritization schemes are used to enable real-time (voice) and non-real-time traffic to coexist on the same channel. The CMTS routes IP telephony calls intermixed with other data traffic.

Figure 4 Simplified VoIP Over Cable Network



Your company can then deploy IP telephony as a local-loop bypass service where voice packets are transferred from the CMTS to:

- A telephony gatekeeper when using H.323; the Cisco uBR924 acts as an H.323 gateway.
- A call agent when using SGCP.

The gatekeeper or call agents manage voice calls. The gateway interconnects the IP network to the public switched telephone network (PSTN).

Voice calls are digitized, encoded, compressed, and packetized in the originating gateway, then decompressed, decoded, and reassembled in the destination gateway. A server maintains subscriber profiles and policy information.

You can place and receive calls without using the local exchange carrier. Two simultaneous voice and fax calls are supported to and from each subscriber site. Multiple telephones and fax devices can be connected to each of the two VoIP telephone lines at a subscriber site, providing the 5 REN limit is adhered to for each telephone line.

Note the following requirements and characteristics of VoIP applications using the Cisco uBR924 cable access router:

- The telephones at each subscriber site must support touch-tone dialing; rotary dialing is not supported.
- Special telephone features such as call waiting, call forwarding, and conferencing are not supported.
- A two-line telephone can be connected to the V1+V2 port on the Cisco uBR924.
- Fax devices—standard Group III and computer-based Group III machines up to 14,400 baud—are supported in Cisco IOS images that support VoIP.

- In general, fax/modem cards are not supported over VoIP links.

Contact your network management, provisioning, or operations team to determine what your network supports.

Voice Handling

The Cisco uBR924 cable access router supports the following compression and decompression algorithms (CODECs):

- G.711 A Law 64000 bps
- G.711 u Law 64000 bps
- G.723.1 5300 bps
- G.723.1 6300 bps
- G.726 16000 bps
- G.726 24000 bps
- G.726 32000 bps
- G.728 16000 bps
- G.729 Annex-A 8000 bps
- G.729 8000 bps — Default CODEC for telephone calls

Caution Because voice transmission is delay-sensitive, a well-engineered network is critical. Fine-tuning your network to adequately support VoIP typically involves a series of protocols and features geared to support Quality of Service (QoS).

To achieve acceptable voice quality and reduce network bandwidth usage, several voice processing techniques and services are employed, including echo cancellation, voice compression, Voice Activity Detection (VAD) or silence compression, and Dual Tone Multi- Frequency (DTMF) tone detection and generation.

The Cisco uBR924 cable access router supports multiple QoS service IDs (SIDs), enabling multiple classes of service on the cable interface. This enables VoIP and data traffic to be treated separately, with all data assigned to a default class of service, while VoIP traffic is assigned to a different class of service. Thus, voice traffic from the Cisco uBR924's telephone ports can take precedence over the data traffic coming from the Ethernet interfaces.

Note Separate class of service (CoS) streams are only available when the Cisco uBR924 is connected to a CMTS that supports multiple classes of service per router. In addition, the router's configuration file must specify the use of multiple classes of service.

If the Cisco uBR924 interoperates with a DOCSIS 1.0 CMTS that does not support multiple CoS per router, voice traffic will be transmitted on a "best effort" basis along with data traffic. This may cause poorer voice quality and lower data throughput when calls are being made from the router's telephone ports.

The Cisco uBR924 cable access router supports the following service classes:

- The first CoS in the router's configuration file is configured as the "Tiered Best Effort Type Class" used by the router as the primary QoS for all regular data traffic. The class has no minimum upstream rate specified for the channel.

  This service class results in the assignment of a primary SID for the router. In addition to being used as a data SID, the router uses this SID for all MAC message exchanges with the CMTS. Any SNMP management traffic from the network to the Cisco uBR924 will also use this SID.

  While this class is strictly "best effort," data traffic within this class can be prioritized into eight different priority levels. The CMTS system administrator, however, must define the supported upstream traffic priority levels and include the traffic priority fields in the configuration file downloaded to the Cisco uBR924.

- When creating a configuration for the Cisco uBR924, the CMTS system administrator typically configures extra classes of service. These secondary classes of service are expected to be higher QoS classes and are used by higher priority traffic such as voice. These classes have a minimum upstream rate specified for the channel.

The multiple SID-per-router feature enables the Cisco uBR924 to use multiple SID queues for differentiated services. The Cisco uBR924 diverts voice call traffic to the higher QoS secondary SID, while forwarding "best effort" data from the Ethernet interface and MAC messages on the primary SID.

H.323 Protocol Stack

H.323 is an International Telecommunications Union (ITU) standard that specifies call signaling and control protocols for a shared IP data network. The Cisco uBR924 cable access router acts as an H.323 gateway. In architectures using the VoIP H.323 protocol stack, the session application manages two call legs for each call: (1) a telephony leg managed by the voice telephony service provider; (2) the VoIP leg managed by the cable system operator—the VoIP service provider. Use of the H.323 protocol typically requires a dial plan and mapper at the headend or other server location to map IP addresses to telephone numbers.

When both legs of the call have been set up, the session application creates a conference between them. The opposite leg's transmit routine for voice packets is given to each provider. The CMTS router passes data to the gateway and gatekeeper. The H.323 stack provides signalling via H.225 and feature negotiation via H.245.

To make and receive H.323 calls, the Cisco uBR924 cable access router must know:

- The IP address of the gateway for the destination dialed. You can configure these IP addresses statically using the **voip dial peer group** CLI commands, or you can obtain these addresses dynamically from the gatekeeper using Registration, Admission, and Status (RAS).
- The telephone numbers of the attached devices. You can configure the telephone numbers attached to the Cisco uBR924 by configuring the IP addresses statically using the **pots port** CLI commands. When using Cisco Network Registrar (CNR) version 3.0 or higher with the relay.tcl and setrouter.tcl scripts, you can obtain these addresses dynamically from CNR. The telephone numbers of attached devices are then sent in DHCP response messages. When the Cisco uBR924 processes the DHCP response, it automatically creates the **pots dial peer** for each port, creates the **voip dial peer** for the RAS target, and starts the H.323 RAS gateway support.

Note To support voice configurations involving Cisco gatekeeper products using RAS, the headend must have IP multicast enabled. The cable interface must be designated as the default for RAS to discover the gatekeeper. The gatekeeper then resolves all dialed destinations sent to the RAS protocol.

SGCP Protocol Stack

The Cisco uBR924 cable access router supports Simple Gateway Control Protocol (SGCP), an out-of-band signaling protocol that interacts with an external call agent (CA) to provide call setup and teardown for VoIP calls made through the Internet or a local intranet. Using the call control agent, SGCP communicates with the voice gateways, allowing you to create a distributed system that enhances performance, reliability, and scalability while still appearing as a single VoIP gateway to external clients. SGCP eliminates the need for a dial plan mapper and static configuration on the router to map IP addresses to telephone numbers because this function is provided by the external call agent.

In architectures using the SGCP protocol stack, the session application implements the gateway functionality defined to support both trunk and residential gateways. The Cisco uBR924 functions in this mode as a residential gateway with two endpoints.

SGCP can preserve Signaling System 7 (SS7) style call control information as well as additional network information such as routing information and authentication, authorization, and accounting (AAA) security information. SGCP allows voice calls to originate and terminate on the Internet, as well as allowing one end to terminate on the Internet and the other to terminate on a telephone or PBX on the PSTN.

Note The uBR924 cable access router supports both H.323 and SGCP call control, but only one method can be active at a time.

Voice Specifications

Table 2 Cisco uBR924 Cable Access Router Voice Specifications

Metric	Value
Loss (between DCS and BTI gateway)	Nominal: 4 dB .5 dB (o**f** hook) Nominal: 9 dB .5 dB (on hook)
Attenuation distortion: DCS <> BTI (200Hz-3.5kHz) BTI<> DCS (304 Hz-3004Hz) DCS -> BTI (204 Hz-3004 Hz)	Nominal: +1 dB/-3 dB 0.5 dB 0.5 dB0
Idle channel noise	<= 18 dBmC (noise shall not exceed)
Signal to C-notched noise	>= 35 dB
Inter-modulation distortion: R2 R3	 >= 52 dB >= 52 dB
Single frequency interference: 0 to 12 kHz 0 to 4 kHz	 <= -28 dBmO <= -40 dBmO

Table 2 Cisco uBR924 Cable Access Router Voice Specifications (continued)

Metric	Value	
Frequency shift (offset)	<= 0.2 Hz (max) <= 0.1 Hz (99.5%)	
Amplitude tracking (input Level, dBmO):	Max Dev.	Ave. Dev.
-37 to 0 (on-hook)	<= .5 dB	
-37 to +3 (off hook)	<= .5 dB	<= .25 dB
-50 to -37 (off-hook)	<= 1.0dB	<= .5 dB
-55 to -50 (off-hook)	<= 3.0 dB	<= 1.5 dB
Crosstalk	<= -65 dBmO	
Amplitude jitter 20-300 Hz 4-300 Hz	 <= 2.5% Peak <= 2.9% Peak	
Phase jitter 20 to 300 Hz 4 to 300 Hz	<= 1.5 P-P <= 1.8 P-P	
Envelope delay distortion: 1704 Hz to 604 Hz 1704 Hz to 2804 Hz 1704 Hz to 204 Hz 1704 Hz to 3404 Hz	<= 350 usec <= 195 usec <= 580 usec <= 400 usec	
Hybrid balance:		
Echo Return Loss (ERL)	> 26 dB (standard test line) > 14 dB (station off hook)	
SRL	> 21 dB (standard test line) > 11 dB (station off hook)	
Clipping: Speech segments <5 ms Speech segments > 5ms	 < 0.5% 0.0%	
Impulse noise: (>= 6 dB below receive signal)	 0 in 93% of all 15 min intervals <= 1 count in all 30 min intervals	
Phase hits (>= 10 deg)	0 in 99.75% of all 15 min intervals <= 1 count in all 30 min intervals	
Gain hits (>= 3dB)	0 in 99.9% of all 15 min intervals <= 1 count in all 30 min intervals	
Dropouts (>= 12)	0 in 99.9% of all 15 min intervals <= 1 count in all 60 min intervals	

Backup POTS Connection

The Cisco uBR924 cable access router provides an RJ-11 port (Line) that connects to a standard analog telephone wall jack. In the event of a building power failure or a Cisco uBR924 power problem, the cutover port lets you dial out using the backup PSTN line. If the Cisco uBR924 loses power while VoIP calls are in progress, you can reestablish one of the two connections—dialing out over the PSTN.

Note The backup POTS connection enables only one of the VoIP ports on the Cisco uBR924 to function during a power outage. Calls in progress prior to the power outage will be disconnected. If power is reestablished while a cutover call is in progress, the connection will remain in place until the call is terminated. Once the cutover call is terminated, the router automatically reboots.

Security Features

Cisco uBR900 series cable access routers support the security features described in the paragraphs below.

DOCSIS Baseline Privacy

Support for DOCSIS Baseline Privacy in the Cisco uBR900 series is based on the DOCSIS Baseline Privacy Interface Specification (SP-BPI-I01-970922). It provides data privacy across the HFC network by encrypting traffic flows between the cable access router and the CMTS.

Baseline Privacy security services are defined as a set of extended services within the DOCSIS MAC sublayer. Two new MAC management message types, BPKM-REQ and BPKM-RSP, are employed to support the Baseline Privacy Key Management (BPKM) protocol.

The BPKM protocol does not use authentication mechanisms such as passwords or digital signatures; it provides basic protection of service by ensuring that a cable modem, uniquely identified by its 48-bit IEEE MAC address, can only obtain keying material for services it is authorized to access. The Cisco uBR900 series cable access router is able to obtain two types of keys from the CMTS: the Traffic Exchange Key (TEK), which is used to encrypt and decrypt data packets, and the Key Exchange Key (KEK), which is used to decrypt the TEK.

IPSec Network Security

IPSec Network Security (IPSec) is an IP security feature that provides robust authentication and encryption of IP packets. IPSec is a framework of open standards developed by the Internet Engineering Task Force (IETF) providing security for transmission of sensitive information over unprotected networks such as the Internet. IPSec acts at the network layer (Layer 3), protecting and authenticating IP packets between participating IPSec devices (“peers”) such as the Cisco uBR900 series cable access router.

IPSec provides the following network security services:

- Privacy—IPSec can encrypt packets before transmitting them across a network.
- Integrity—IPSec authenticates packets at the destination peer to ensure that the data has not been altered during transmission.
- Authentication—Peers authenticate the source of all IPSec-protected packets.
- Anti-replay protection—Prevents capture and replay of packets; helps protect against denial-of-service attacks.

Triple Data Encryption Standard

The Data Encryption Standard (DES) is a standard cryptographic algorithm developed by the United States National Bureau of Standards. The Triple DES (3DES) Cisco IOS Software Release images increase the security from the standard 56-bit IPSec encryption to 168-bit encryption, which is used for highly sensitive and confidential information such as financial transactions and medical records.

Firewall

Cisco uBR900 series cable access routers act as buffers between any connected public and private networks. In firewall mode, Cisco cable access routers use access lists and other methods to ensure the security of the private network.

Cisco IOS firewall-specific security features include:

- Context-based Access Control (CBAC). This intelligently filters TCP and UDP packets based on the application-layer protocol. Java applets can be blocked completely, or allowed only from known and trusted sources.
- Detection and prevention of the most common denial of service (DoS) attacks such as ICMP and UDP echo packet flooding, SYN packet flooding, half-open or other unusual TCP connections, and deliberate mis-fragmentation of IP packets.
- Support for a broad range of commonly used protocols, including H.323 and NetMeeting, FTP, HTTP, MS Netshow, RPC, SMTP, SQL*Net, and TFTP.
- Authentication Proxy for authentication and authorization of web clients on a per-user basis.
- Dynamic Port Mapping. Maps the default port numbers for well-known applications to other port numbers. This can be done on a host-by-host basis or for an entire subnet, providing a large degree of control over which users can access different applications.
- Intrusion Detection System (IDS) that recognizes the signatures of 59 common attack profiles. When an intrusion is detected, IDS can either send an alarm to a syslog server or to a NetRanger Director, drop the packet, or reset the TCP connection.
- User-configurable audit rules.
- Configurable real-time alerts and audit trail logs.

For additional information, see the description of the *Cisco IOS Firewall Feature Set* in the Cisco *Product Catalog*, or refer to the sections on Traffic Filtering and Firewalls in the *Security Configuration Guide* and *Security Command Reference* available on Cisco Connection Online (CCO) and the Documentation CD-ROM.

NetRanger Support—IOS Intrusion Detection

NetRanger is an Intrusion Detection System (IDS) composed of three parts:

- A management console (director) that is used to view the alarms as well as to manage the sensors.
- A sensor that monitors traffic. This traffic is matched against a list of known signatures to detect misuse of the network. This is usually in the form of scanning for vulnerabilities or for attacking systems. When a signature is matched, the sensor can track certain actions. In the case of the appliance sensor, it can reset (via TCP/rst) sessions, or enable “shuns” of further traffic. In the case of the IOS-IDS, it can drop traffic. In all cases, the sensor can send alarms to the director.
- Communications through automated report generation of standardized and customizable reports and QoS/CoS monitoring capabilities.

Configuration Options

The Cisco uBR900 series cable access router typically ships from the factory ready to work in the Base IP Bridging (DOCSIS-compliant bridging) data-only mode. The cable access router is configured automatically at startup by one or more configuration files generated by the cable service provider and downloaded to the router; no configuration or setup is required other than to connect the router to the cable system. The CMTS provides a path from the cable access router to the DHCP server for PC address assignment.

The PCs connected to the Cisco uBR900 series must be configured for Internet Protocol (IP). Using DHCP, the CMTS assigns an IP subnet address to the cable access router each time it connects to the network. The IP addresses of the cable access router and the individual PCs attached to it enable the CMTS to route data to and from the PCs.

Note When the Cisco uBR900 series cable access router is shipped from the factory, it is configured by default for DOCSIS-compliant bridging.

The configuration file or files downloaded to the Cisco uBR900 series by the CMTS at the headend are dependent on the services purchased by the individual cable service subscriber. The cable access router is provisioned in the following manner:

- When the cable access router is first brought online, the CMTS downloads a binary file to the router that is in DOCSIS-specified format. This file configures the router for the desired level of service and sets other parameters as needed.
- If additional features are required beyond basic DOCSIS-compliant bridging, the DOCSIS configuration file can specify a Cisco IOS image that the CMTS should also download to the router. (To speed up the time required to bring the router online, the cable service provider can optionally preload the Cisco uBR900 series with the appropriate image at the warehouse.)
- To customize the cable access router's configuration further, the DOCSIS configuration file can also specify a Cisco IOS configuration file that the CMTS should download to the router. This second configuration file is an ASCII text file that contains the Cisco IOS commands needed to further configure the router as desired.

Note The CMTS typically downloads the DOCSIS configuration file, Cisco IOS image (if needed), and the Cisco IOS configuration file (if needed) only once when the router is initially brought online. However, a new configuration file or image can be downloaded whenever necessary, such as when the cable service provider offers new services or subscribers upgrade their services.

To ensure that you obtain the exact services that you have ordered, the Cisco uBR900 series arrives from the factory with a unique identifier (UID) that consists of a serial number and MAC address. These factory-assigned values are on a label at the bottom of the cable access router; for convenience, these values are also in a barcode label that can be easily scanned for entry into the service provider's provisioning and billing system.

Using the MAC address of the cable access router as the key, the CMTS downloads the DOCSIS configuration file and Cisco IOS image that will provide the services that you have purchased. Service technicians at the headend typically create a number of standard configuration files to match the range of services offered by the provider; these configuration files can be created manually or with tools provided for this purpose by Cisco Systems.

The following sections describe the initial power-on and provisioning sequences in more detail, as well as the requirements that must be met by both the cable access router and the CMTS before provisioning can be successful.

Initial Power-On Sequence

When connected and first powered on, the Cisco uBR900 series cable access router performs the following boot procedures:

- Boots the Read Only Memory (ROM) from the ROMMON partition of its flash memory.
- Performs a self-test, initializes processor hardware, and boots the main operating system software—the Cisco IOS release image stored in NVRAM.

Next, the Cisco uBR900 series performs a series of DOCSIS-mandated procedures for automatic installation and configuration. These procedures are summarized in Table 3 and in Figure 5.

.

Table 3 Cable Access Router Initialization Sequences and Events

Sequence	Event	Description
1	Scan for a downstream channel and establish synchronization with the CMTS.	The Cisco uBR900 series acquires a downstream channel by matching the clock sync signal that is regularly sent out by the CMTS on the downstream channel. The cable access router saves the last operational frequency in non-volatile memory and tries to reacquire the saved downstream channel the next time a request is made. **Note** An ideal downstream signal is one that synchronizes QAM symbol timing, FEC framing, MPEG packetization, and recognizes downstream sync MAC layer messages.
2	Obtain upsteam channel parameters.	The cable access router waits for an upstream channel descriptor (UCD) message from the CMTS and configures itself for the upstream frequence specified in that message.
3	Start ranging for power adjustments.	The cable access router waits for the next upstream bandwidth allocation map message (MAP) from the CMTS to find the next shared request timeslot. The router then sends a ranging request message on the next available shared request timeslot, communicating its UID (its unique MAC address) using a temporary Service Identifier (SID) of 0 (zero) to indicate it has not yet been allocated an upstream channel. In reply to the cable access router's ranging request, the CMTS sends a ranging response containing a temporary SID to be used for the initial router configuration and bandwidth allocation. As needed, the router adjusts its transmit power levels using the power increment value given by the CMTS in its ranging response message. **Note** At this point, the cable access router has established connectivity with the CMTS but is not yet online. The next steps allocate "permanent" upstream and downstream frequencies, as well as the configuration required for IP network connectivity.

Table 3 Cable Access Router Initialization Sequences and Events (continued)

Sequence	Event	Description
4	Establish IP connectivity.	After the next MAP message broadcast, the router uses a shared require timeslot to invoke Dynamic Host Configuration Protocol (DHCP) to establish IP connectivity with the TCP/IP network at the headend. The DHCP server sends a response containing the router's IP address as well as the IP addresses for the default gateway, time of day (TOD) server, and Trivial File Transfer Protocol (TFTP) server, and the DOCSIS configuration file to be downloaded. Depending on the particular network configuration, other information could be provided, such as the IP addresses for a syslog server or security server. **Note** The DHCP server is typically a dedicated server at the headend, but it could also be a CMTS such as a Cisco uBR7200 series universal broadband router. The router configures itself for the specified IP address and gets the current date and time from the specified TOD server.
5	Establish the time of day.	The cable access router accesses the TOD server for the current date and time, which is used to create time stamps for logged events (such as those displayed in the MAC log file).
6	Establish security.	Full Security, a planned enhancement to Baseline Privacy, is not fully defined nor currently supported by the DOCSIS specification, and is therefore not supported by the Cisco uBR900 series.
7	Transfer operational parameters.	Using TFTP, the router downloads the specified DOCSIS configuration file and configures itself for the appropriate parameters. The DOCSIS configuration file defines the router's operating mode such as the provisioned downstream and upstream service assignments, including assigned frequencies, data rates, modulation schemes, Class of Service (CoS), type of services to support, and other parameters. Cisco provides tools to help automate the creation of configuration files. **Note** The DOCSIS configuration file must be in the exact format given by the DOCSIS specification. An incorrect DOCSIS configuration file can cause the Cisco uBR900 series to constantly cycle offline. Such errors include wrong downstream frequency, wrong UCD, wrong downstream Channel ID, invalid CoS, incorrect BPI privacy configurations or shared secret strings. The cable access router sends another registration request to the CMTS containing the CoS parameters given in the DOCSIS configuration file. The CMTS verifies that the router is using the appropriate CoS profile and converts the temporary SID into a data SID with a service class index that points to the applicable CoS profile.
8	Perform registration.	The router completes its secondary ranging and is then online, passing data between the HFC network and the PCs and other CPE devices that are connected to the router.

Table 3 Cable Access Router Initialization Sequences and Events (continued)

Sequence	Event	Description
9	Comply with baseline privacy.	If baseline privacy is configured and enabled on both the router and CMTS, the router and CMTS negotiate the appropriate encryption/decryption parameters and exchange keys for privacy. After encryption is enabled, all information sent within Ethernet packets is encrypted to prevent interception or modification by an unauthorized party.
10	Enter the operational maintenance state.	As soon as the Cisco uBR900 series cable access router has successfully completed the above sequence, it enters operational maintenance state.

At this point the router is online and operational in the basic DOCSIS bridging (“plug and play”) mode. If the DOCSIS configuration file specifies that the router must download a Cisco IOS image and a Cisco IOS configuration file, the router uses TFTP to download the image and configuration file into its local memory. It then installs the new IOS image and runs the configuration file.

Downloading a DOCSIS configuration file to a Cisco uBR900 series cable access router automatically:

- ends all telnet sessions
- disables the cable access router’s console port, preventing local access to the router’s CLI
- performs a “write erase” on the cable access router’s local configuration parameters

Telnet access to the router from the headend is still allowed, but only if the Cisco IOS configuration file includes **enable** and **line vty** passwords; if the configuration file does not include **enable** and **line vty** commands to specify these passwords, Telnet access and console access are both disabled.

The sequence numbers shown in Table 3 are also shown in Figure 5 below. The Cisco uBR900 series cable access router will complete all the steps shown in the table and flowchart each time it needs to reregister with the CMTS.

Figure 5 Cable Modem Initialization Flowchart

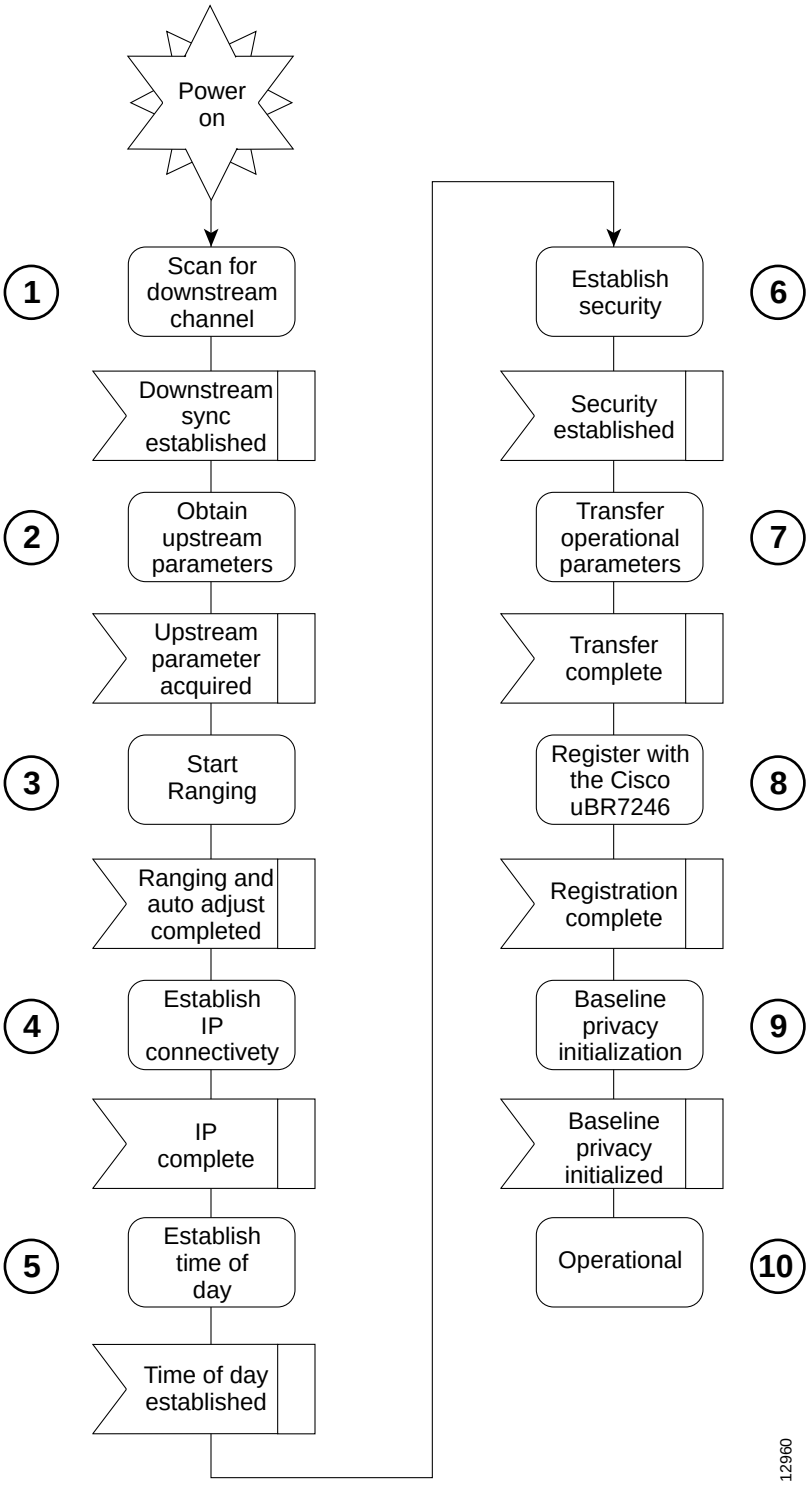
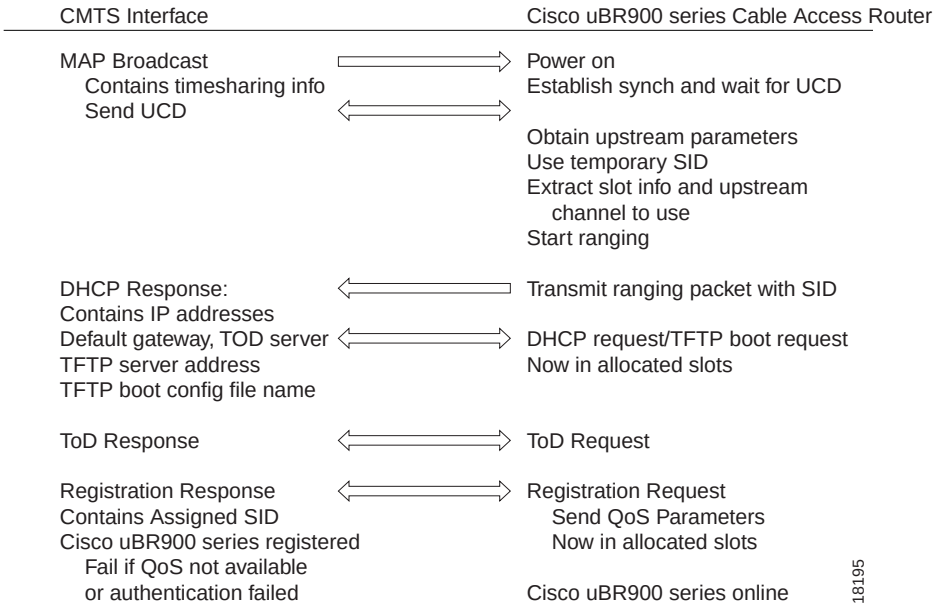


Figure 6 illustrates the traffic flow during the initialization process.

Figure 6 Cisco uBR900 Series Cable Access Router Provisioning Overview



Note For more detail on the provisioning process, see the DOCSIS 1.0 Radio Frequency Interface (RFI) specification (SP-RFII01-990731 or later revision).

After the Cisco uBR900 series cable access router goes online, it begins transferring data between the attached CPE devices and the network (internet, intranet, VoIP). The cable service provider typically uses DHCP to assign IP addresses to the CPE devices. The number of IP addresses each subscriber can obtain depends on the services purchased from the provider.

Basic Troubleshooting

A MAC-layer circular log file is stored inside the Cisco uBR900 series cable access router. This file contains a history of the log messages such as state event activities and timestamps. This is the most valuable information for troubleshooting the cable interface.

The MAC log file is displayed by entering the **show controllers cable-modem 0 mac log** command from privileged EXEC mode.

The most useful display fields in this output are the reported state changes. These fields are preceded by the message `CMAC_LOG_STATE_CHANGE`. These fields show how the Cisco uBR900 series progresses through the various processes involved in establishing communication and registration with the CMTS. The normal operational state is `maintenance_state` ; the normal state when the interface is shut down is `wait_for_link_up_state`.

Note Because the MAC log file holds only a snapshot of 1023 entries at a time, you should try to display the file within 5 minutes after the reset or problem occurs.

The following is the normal progression of states as the Cisco uBR900 series registers with the CMTS:

```
wait_for_link_up_state
ds_channel_scanning_state
wait_ucd_state
wait_map_state
ranging_1_state
ranging_2_state
dhcp_state
establish_tod_state
security_association_state
configuration_file_state
registration_state
establish_privacy_state
maintenance_state
```

Following is an example of a MAC log file for a cable access router that has successfully registered with the headend CMTS. The output that is displayed is directly related to the messages that are exchanged between the Cisco uBR900 series and the CMTS.

```
uBR924# show controllers cable-modem 0 mac log
508144.340 CMAC_LOG_DRIVER_INIT_IDB_RESET              0x08098FEA
508144.342 CMAC_LOG_LINK_DOWN
508144.344 CMAC_LOG_LINK_UP
508144.348 CMAC_LOG_STATE_CHANGE                       ds_channel_scanning_state
508144.350 CMAC_LOG_WILL_SEARCH_DS_FREQUENCY_BAND      88/453000000/855000000/6000000
508144.354 CMAC_LOG_WILL_SEARCH_DS_FREQUENCY_BAND      89/93000000/105000000/6000000
508144.356 CMAC_LOG_WILL_SEARCH_DS_FREQUENCY_BAND      90/111250000/117250000/6000000
508144.360 CMAC_LOG_WILL_SEARCH_DS_FREQUENCY_BAND      91/231012500/327012500/6000000
508144.362 CMAC_LOG_WILL_SEARCH_DS_FREQUENCY_BAND      92/333015000/333015000/6000000
508144.366 CMAC_LOG_WILL_SEARCH_DS_FREQUENCY_BAND      93/339012500/399012500/6000000
508144.370 CMAC_LOG_WILL_SEARCH_DS_FREQUENCY_BAND      94/405000000/447000000/6000000
508144.372 CMAC_LOG_WILL_SEARCH_DS_FREQUENCY_BAND      95/123015000/129015000/6000000
508144.376 CMAC_LOG_WILL_SEARCH_DS_FREQUENCY_BAND      96/135012500/135012500/6000000
508144.380 CMAC_LOG_WILL_SEARCH_DS_FREQUENCY_BAND      97/141000000/171000000/6000000
508144.382 CMAC_LOG_WILL_SEARCH_DS_FREQUENCY_BAND      98/219000000/225000000/6000000
508144.386 CMAC_LOG_WILL_SEARCH_DS_FREQUENCY_BAND      99/177000000/213000000/6000000
508144.390 CMAC_LOG_WILL_SEARCH_SAVED_DS_FREQUENCY     699000000
508145.540 CMAC_LOG_UCD_MSG_RCVD                       3
508146.120 CMAC_LOG_DS_64QAM_LOCK_ACQUIRED             699000000
508146.122 CMAC_LOG_DS_CHANNEL_SCAN_COMPLETED
508146.124 CMAC_LOG_STATE_CHANGE                       wait_ucd_state
508147.554 CMAC_LOG_UCD_MSG_RCVD                       3
508147.558 CMAC_LOG_UCD_NEW_US_FREQUENCY               20000000
508147.558 CMAC_LOG_SLOT_SIZE_CHANGED                  8
508147.622 CMAC_LOG_FOUND_US_CHANNEL                   1
508147.624 CMAC_LOG_STATE_CHANGE                       wait_map_state
508148.058 CMAC_LOG_MAP_MSG_RCVD
508148.060 CMAC_LOG_INITIAL_RANGING_MINISLOTS          40
508148.062 CMAC_LOG_STATE_CHANGE                       ranging_1_state
508148.064 CMAC_LOG_RANGING_OFFSET_SET_TO              9610
508148.066 CMAC_LOG_POWER_LEVEL_IS                     28.0  dBmV (commanded)
508148.068 CMAC_LOG_STARTING_RANGING
508148.070 CMAC_LOG_RANGING_BACKOFF_SET                0
508148.072 CMAC_LOG_RNG_REQ_QUEUED                     0
508148.562 CMAC_LOG_RNG_REQ_TRANSMITTED
508148.566 CMAC_LOG_RNG_RSP_MSG_RCVD
508148.568 CMAC_LOG_RNG_RSP_SID_ASSIGNED               2
508148.570 CMAC_LOG_ADJUST_RANGING_OFFSET              2408
508148.572 CMAC_LOG_RANGING_OFFSET_SET_TO              12018
508148.574 CMAC_LOG_ADJUST_TX_POWER                    20
508148.576 CMAC_LOG_POWER_LEVEL_IS                     33.0  dBmV (commanded)
508148.578 CMAC_LOG_STATE_CHANGE                       ranging_2_state
```

```
508148.580 CMAC_LOG_RNG_REQ_QUEUED                    2
508155.820 CMAC_LOG_RNG_REQ_TRANSMITTED
508155.824 CMAC_LOG_RNG_RSP_MSG_RCVD
508155.826 CMAC_LOG_ADJUST_RANGING_OFFSET             -64
508155.826 CMAC_LOG_RANGING_OFFSET_SET_TO             11954
508155.828 CMAC_LOG_RANGING_CONTINUE
508165.892 CMAC_LOG_RNG_REQ_TRANSMITTED
508165.894 CMAC_LOG_RNG_RSP_MSG_RCVD
508165.896 CMAC_LOG_ADJUST_TX_POWER                   -9
508165.898 CMAC_LOG_POWER_LEVEL_IS                    31.0  dBmV (commanded)
508165.900 CMAC_LOG_RANGING_CONTINUE
508175.962 CMAC_LOG_RNG_REQ_TRANSMITTED
508175.964 CMAC_LOG_RNG_RSP_MSG_RCVD
508175.966 CMAC_LOG_RANGING_SUCCESS
508175.968 CMAC_LOG_STATE_CHANGE                      dhcp_state
508176.982 CMAC_LOG_DHCP_ASSIGNED_IP_ADDRESS          188.188.1.62
508176.984 CMAC_LOG_DHCP_TFTP_SERVER_ADDRESS          4.0.0.1
508176.986 CMAC_LOG_DHCP_TOD_SERVER_ADDRESS           4.0.0.32
508176.988 CMAC_LOG_DHCP_SET_GATEWAY_ADDRESS
508176.988 CMAC_LOG_DHCP_TZ_OFFSET                    360
508176.990 CMAC_LOG_DHCP_CONFIG_FILE_NAME             platinum.cm
508176.992 CMAC_LOG_DHCP_ERROR_ACQUIRING_SEC_SVR_ADDR
508176.996 CMAC_LOG_DHCP_COMPLETE
508177.120 CMAC_LOG_STATE_CHANGE                      establish_tod_state
508177.126 CMAC_LOG_TOD_REQUEST_SENT
508177.154 CMAC_LOG_TOD_REPLY_RECEIVED                3107617539
508177.158 CMAC_LOG_TOD_COMPLETE
508177.160 CMAC_LOG_STATE_CHANGE                      security_association_state
508177.162 CMAC_LOG_SECURITY_BYPASSED
508177.164 CMAC_LOG_STATE_CHANGE                      configuration_file_state
508177.166 CMAC_LOG_LOADING_CONFIG_FILE               platinum.cm
508178.280 CMAC_LOG_CONFIG_FILE_PROCESS_COMPLETE
508178.300 CMAC_LOG_STATE_CHANGE                      registration_state
508178.302 CMAC_LOG_REG_REQ_MSG_QUEUED
508178.306 CMAC_LOG_REG_REQ_TRANSMITTED
508178.310 CMAC_LOG_REG_RSP_MSG_RCVD
508178.312 CMAC_LOG_COS_ASSIGNED_SID                  5/19
508178.314 CMAC_LOG_COS_ASSIGNED_SID                  6/20
508178.316 CMAC_LOG_COS_ASSIGNED_SID                  7/21
508178.318 CMAC_LOG_RNG_REQ_QUEUED                    19
508178.320 CMAC_LOG_REGISTRATION_OK
508178.322 CMAC_LOG_REG_RSP_ACK_MSG_QUEUED            0
508178.324 CMAC_LOG_STATE_CHANGE                      establish_privacy_state
508178.326 CMAC_LOG_NO_PRIVACY
508178.328 CMAC_LOG_STATE_CHANGE                      maintenance_state
```

You can display other aspects of the MAC layer by adding the following keywords to the **show controllers cable-modem 0 mac** command:

```
uBR924# show controllers cable-modem 0 mac ?
  errors    Mac Error Log data
  hardware  All CM Mac Hardware registers
  log       Mac log data
  resets    Resets of the MAC
  state     Current MAC state
```

For examples and descriptions of how to use these keywords, see the **show controllers cable-modem mac** command reference page.

The MAC log file gives a detailed history of initialization events that occur in the Cisco uBR900 series cable access router. All pertinent troubleshooting information is stored here.

In the following paragraphs, a sample log file is broken down into the chronological sequence of events listed below. Sample comments are also included in the log file.

- Event 1—Wait for the Link to Come Up
- Event 2—Scan for a Downstream Channel, then Synchronize
- Event 3—Obtain Upstream Parameters
- Event 4—Start Ranging for Power Adjustments
- Event 5—Establish IP Connectivity
- Event 6—Establish the Time of Day
- Event 7—Establish Security
- Event 8—Transfer Operational Parameters
- Event 9—Perform Registration
- Event 10—Comply with Baseline Privacy
- Event 11—Enter the Maintenance State

Event 1—Wait for the Link to Come Up

When the Cisco uBR900 series cable access router is powered on and begins initialization, the MAC layer first informs the cable access router drivers that it needs to reset. The `LINK_DOWN` and `LINK_UP` fields are similar to the shut and no shut conditions on a standard Cisco interface.

```
uBR924# show controllers cable-modem 0 mac log
528302.040 CMAC_LOG_LINK_DOWN
528302.042 CMAC_LOG_RESET_FROM_DRIVER
528302.044 CMAC_LOG_STATE_CHANGE                        wait_for_link_up_state
528302.046 CMAC_LOG_DRIVER_INIT_IDB_SHUTDOWN            0x08098D02
528302.048 CMAC_LOG_LINK_DOWN
528308.428 CMAC_LOG_DRIVER_INIT_IDB_RESET               0x08098E5E
528308.432 CMAC_LOG_LINK_DOWN
528308.434 CMAC_LOG_LINK_UP
```

Event 2—Scan for a Downstream Channel, then Synchronize

Different geographical regions and different cable plants use different RF frequency bands. A frequency band is a group of adjacent 6 MHz-wide channels. These bands are numbered from 88 to 99. Each band has starting and ending digital carrier frequencies and a 6 MHz step size. For example, a search of EIA channels 95-97 is specified using band 89. The starting frequency of band 89 is 93 MHz; the ending frequency is 105 MHz.

The Cisco uBR900 series' default frequency bands correspond to the North American EIA CATV channel plan for 6 MHz channel slots between 90 and 858 MHz. For example, EIA channel 95 occupies the 90-96 MHz slot. The digital carrier frequency is specified as the center frequency of the slot, which is 93 MHz. Channel 95 is usually specified using the analog video carrier frequency of 91.25 MHz, which lies 1.75 MHz below the center of the slot.

Some CATV systems use alternative frequency plans such as the IRC (Incrementally Related Carrier) plan and HRC (Harmonically Related Carrier) plan. Cisco uBR900 series cable access routers support both of these plans. Most of the IRC channel slots overlap the EIA plan.

The Cisco uBR900 series uses a built-in default frequency scanning feature to find and lock onto a downstream channel. After the cable access router successfully finds a downstream frequency channel, it saves the channel to NVRAM. The router recalls this value the next time it needs to synchronize its frequency.

The downstream frequency search table is arranged so that the first frequencies that are scanned are above 450 MHz. Because many CATV systems have been upgraded from 450 MHz to 750 MHz coaxial cable, digital channels have a high chance of being assigned in the new spectrum. The search table omits channels below 90 MHz and above 860 MHz since the DOCSIS specification does not mandate their coverage.

The `CMAC_LOG_WILL_SEARCH_DS_FREQUENCY_BAND` field tells you what frequencies the cable access router will scan. The `CMAC_LOG_WILL_SEARCH_SAVED_DS_FREQUENCY` field tells you the frequency the router locked onto and saved to NVRAM for future recall. The `CMAC_LOG_DS_64QAM_LOCK_ACQUIRED` field communicates the same information. The `CMAC_LOG_DS_CHANNEL_SCAN_COMPLETED` field indicates that the scanning and synchronization was successful.

```
508144.348 CMAC_LOG_STATE_CHANGE                        ds_channel_scanning_state
508144.350 CMAC_LOG_WILL_SEARCH_DS_FREQUENCY_BAND       88/453000000/855000000/6000000
508144.354 CMAC_LOG_WILL_SEARCH_DS_FREQUENCY_BAND       89/93000000/105000000/6000000
508144.356 CMAC_LOG_WILL_SEARCH_DS_FREQUENCY_BAND       90/111250000/117250000/6000000
508144.360 CMAC_LOG_WILL_SEARCH_DS_FREQUENCY_BAND       91/231012500/327012500/6000000
508144.362 CMAC_LOG_WILL_SEARCH_DS_FREQUENCY_BAND       92/333015000/333015000/6000000
508144.366 CMAC_LOG_WILL_SEARCH_DS_FREQUENCY_BAND       93/339012500/399012500/6000000
508144.370 CMAC_LOG_WILL_SEARCH_DS_FREQUENCY_BAND       94/405000000/447000000/6000000
508144.372 CMAC_LOG_WILL_SEARCH_DS_FREQUENCY_BAND       95/123015000/129015000/6000000
508144.376 CMAC_LOG_WILL_SEARCH_DS_FREQUENCY_BAND       96/135012500/135012500/6000000
508144.380 CMAC_LOG_WILL_SEARCH_DS_FREQUENCY_BAND       97/141000000/171000000/6000000
508144.382 CMAC_LOG_WILL_SEARCH_DS_FREQUENCY_BAND       98/219000000/225000000/6000000
508144.386 CMAC_LOG_WILL_SEARCH_DS_FREQUENCY_BAND       99/177000000/213000000/6000000
508144.390 CMAC_LOG_WILL_SEARCH_SAVED_DS_FREQUENCY      699000000
508145.540 CMAC_LOG_UCD_MSG_RCVD                        3
508146.120 CMAC_LOG_DS_64QAM_LOCK_ACQUIRED              699000000
508146.122 CMAC_LOG_DS_CHANNEL_SCAN_COMPLETED
```

Event 3—Obtain Upstream Parameters

The Cisco uBR900 series waits for an upstream channel descriptor (UCD) message from the CMTS. The UCD provides transmission parameters for the upstream channel.

```
508146.124 CMAC_LOG_STATE_CHANGE                        wait_ucd_state
508147.554 CMAC_LOG_UCD_MSG_RCVD                        3
508147.558 CMAC_LOG_UCD_NEW_US_FREQUENCY                20000000
508147.558 CMAC_LOG_SLOT_SIZE_CHANGED                   8
508147.622 CMAC_LOG_FOUND_US_CHANNEL                    1
508147.624 CMAC_LOG_STATE_CHANGE                        wait_map_state
508148.058 CMAC_LOG_MAP_MSG_RCVD
508148.060 CMAC_LOG_INITIAL_RANGING_MINISLOTS           40
```

Event 4—Start Ranging for Power Adjustments

The ranging process adjusts the transmit power of the cable access router. Ranging is performed in two stages: ranging state 1 and ranging state 2.

The `CMAC_LOG_POWER_LEVEL_IS` field is the power level that the CMTS told the Cisco uBR900 series to adjust to. The `CMAC_LOG_RANGING_SUCCESS` field indicates that the ranging adjustment was successful.

```
508148.062 CMAC_LOG_STATE_CHANGE                        ranging_1_state
508148.064 CMAC_LOG_RANGING_OFFSET_SET_TO               9610
508148.066 CMAC_LOG_POWER_LEVEL_IS                      28.0  dBmV (commanded)
508148.068 CMAC_LOG_STARTING_RANGING
508148.070 CMAC_LOG_RANGING_BACKOFF_SET                 0
508148.072 CMAC_LOG_RNG_REQ_QUEUED                      0
508148.562 CMAC_LOG_RNG_REQ_TRANSMITTED
508148.566 CMAC_LOG_RNG_RSP_MSG_RCVD
```

```
508148.568 CMAC_LOG_RNG_RSP_SID_ASSIGNED              2
508148.570 CMAC_LOG_ADJUST_RANGING_OFFSET             2408
508148.572 CMAC_LOG_RANGING_OFFSET_SET_TO             12018
508148.574 CMAC_LOG_ADJUST_TX_POWER                   20
508148.576 CMAC_LOG_POWER_LEVEL_IS                    33.0  dBmV (commanded)
508148.578 CMAC_LOG_STATE_CHANGE                      ranging_2_state
508148.580 CMAC_LOG_RNG_REQ_QUEUED                    2
508155.820 CMAC_LOG_RNG_REQ_TRANSMITTED
508155.824 CMAC_LOG_RNG_RSP_MSG_RCVD
508155.826 CMAC_LOG_ADJUST_RANGING_OFFSET             -64
508155.826 CMAC_LOG_RANGING_OFFSET_SET_TO             11954
508155.828 CMAC_LOG_RANGING_CONTINUE
508165.892 CMAC_LOG_RNG_REQ_TRANSMITTED
508165.894 CMAC_LOG_RNG_RSP_MSG_RCVD
508165.896 CMAC_LOG_ADJUST_TX_POWER                   -9
508165.898 CMAC_LOG_POWER_LEVEL_IS                    31.0  dBmV (commanded)
508165.900 CMAC_LOG_RANGING_CONTINUE
508175.962 CMAC_LOG_RNG_REQ_TRANSMITTED
508175.964 CMAC_LOG_RNG_RSP_MSG_RCVD
508175.966 CMAC_LOG_RANGING_SUCCESS
```

Event 5—Establish IP Connectivity

After ranging is complete, the cable interface on the cable access router is UP. Now the cable access router accesses a remote DHCP server to get an IP address. The DHCP server sends a response containing the router's IP address plus the TFTP server's address, the Time of Day (TOD) server's address, and the name of a configuration file containing additional configuration parameters. The `CMAC_LOG_DHCP_COMPLETE` field shows that the IP connectivity was successful.

```
508175.968 CMAC_LOG_STATE_CHANGE                      dhcp_state
508176.982 CMAC_LOG_DHCP_ASSIGNED_IP_ADDRESS          188.188.1.62
508176.984 CMAC_LOG_DHCP_TFTP_SERVER_ADDRESS          4.0.0.1
508176.986 CMAC_LOG_DHCP_TOD_SERVER_ADDRESS           4.0.0.32
508176.988 CMAC_LOG_DHCP_SET_GATEWAY_ADDRESS
508176.988 CMAC_LOG_DHCP_TZ_OFFSET                    360
508176.990 CMAC_LOG_DHCP_CONFIG_FILE_NAME             platinum.cm
508176.992 CMAC_LOG_DHCP_ERROR_ACQUIRING_SEC_SVR_ADDR
508176.996 CMAC_LOG_DHCP_COMPLETE
```

Event 6—Establish the Time of Day

The Cisco uBR900 series accesses the Time of Day server for the current date and time, which is used to create time stamps for logged events. The `CMAC_LOG_TOD_COMPLETE` field indicates a successful time of day sequence.

```
508177.120 CMAC_LOG_STATE_CHANGE                      establish_tod_state
508177.126 CMAC_LOG_TOD_REQUEST_SENT
508177.154 CMAC_LOG_TOD_REPLY_RECEIVED                3107617539
508177.158 CMAC_LOG_TOD_COMPLETE
```

Event 7—Establish Security

This event is currently bypassed by the Cisco uBR900 series because "full security" has not been fully defined by DOCSIS and is therefore not yet supported.

```
508177.160 CMAC_LOG_STATE_CHANGE                      security_association_state
508177.162 CMAC_LOG_SECURITY_BYPASSED
```

Note "Full security" was a request made by cable service providers for a very strong authorization and authentication check by the CMTS. The Cisco uBR900 series supports DOCSIS baseline privacy (Event 10), which protects your data from being "sniffed" on the cable network.

Event 8—Transfer Operational Parameters

After completing the DHCP and security operations, the Cisco uBR900 series downloads operational parameters by downloading a configuration file located on the TFTP server. The `CMAC_LOG_DHCP_CONFIG_FILE_NAME` field shows the filename containing the transmission parameters.

```
508177.164 CMAC_LOG_STATE_CHANGE                    configuration_file_state
508177.166 CMAC_LOG_LOADING_CONFIG_FILE             platinum.cm
508178.280 CMAC_LOG_CONFIG_FILE_PROCESS_COMPLETE
```

Event 9—Perform Registration

After the Cisco uBR900 series is initialized, authenticated, and configured, it requests to be registered with the headend CMTS. The `CMAC_LOG_COS_ASSIGNED_SID` field assigns a class of service (CoS) number and a service ID (SID). Multiple CoS entries in the configuration file imply that multiple SIDs are supported by the cable access router. If several cable access routers use the same configuration file, they will have the same CoS numbers but will be assigned different SIDs.

A successful registration is indicated by the `CMAC_LOG_REGISTRATION_OK` field.

```
508178.300 CMAC_LOG_STATE_CHANGE                    registration_state
508178.302 CMAC_LOG_REG_REQ_MSG_QUEUED
508178.306 CMAC_LOG_REG_REQ_TRANSMITTED
508178.310 CMAC_LOG_REG_RSP_MSG_RCVD
508178.312 CMAC_LOG_COS_ASSIGNED_SID                5/19
508178.314 CMAC_LOG_COS_ASSIGNED_SID                6/20
508178.316 CMAC_LOG_COS_ASSIGNED_SID                7/21
508178.318 CMAC_LOG_RNG_REQ_QUEUED                  19
508178.320 CMAC_LOG_REGISTRATION_OK
```

Event 10—Comply with Baseline Privacy

During this event, keys for baseline privacy are exchanged between the Cisco uBR900 series and the headend CMTS. A link level encryption is performed so that your data cannot be "sniffed" by anyone else on the cable network.

Following is a trace showing baseline privacy enabled. The key management protocol is responsible for exchanging two types of keys: KEKs and TEKs. The KEK (key exchange key, also referred to as the authorization key) is used by the CMTS to encrypt the TEKs (traffic encryption keys) it sends to the Cisco uBR900 series. The TEKs are used to encrypt/decrypt the data. There is a TEK for each SID that is configured to use privacy.

```
   851.088 CMAC_LOG_STATE_CHANGE                       establish_privacy_state
   851.094 CMAC_LOG_PRIVACY_FSM_STATE_CHANGE           machine: KEK, event/state:
EVENT_1_PROVISIONED/STATE_A_START, new state: STATE_B_AUTH_WAIT
   851.102 CMAC_LOG_BPKM_REQ_TRANSMITTED
   851.116 CMAC_LOG_BPKM_RSP_MSG_RCVD
   851.120 CMAC_LOG_PRIVACY_FSM_STATE_CHANGE           machine: KEK, event/state:
EVENT_3_AUTH_REPLY/STATE_B_AUTH_WAIT, new state: STATE_C_AUTHORIZED
   856.208 CMAC_LOG_PRIVACY_FSM_STATE_CHANGE           machine: TEK, event/state:
EVENT_2_AUTHORIZED/STATE_A_START, new state: STATE_B_OP_WAIT
   856.220 CMAC_LOG_BPKM_REQ_TRANSMITTED
   856.224 CMAC_LOG_BPKM_RSP_MSG_RCVD
   856.230 CMAC_LOG_PRIVACY_FSM_STATE_CHANGE           machine: TEK, event/state:
EVENT_8_KEY_REPLY/STATE_B_OP_WAIT, new state: STATE_D_OPERATIONAL
   856.326 CMAC_LOG_PRIVACY_INSTALLED_KEY_FOR_SID      2
   856.330 CMAC_LOG_PRIVACY_ESTABLISHED
```

Note In order for baseline privacy to work, you must use a code image name on the Cisco uBR900 series that contains the characters **k1**. In addition, baseline privacy must be supported on the headend CMTS, and it must be turned on in the configuration file that is downloaded to the cable access router.

Event 11—Enter the Maintenance State

As soon as the Cisco uBR900 series has successfully completed the above events, it enters the operational maintenance state and is authorized to forward traffic into the cable network.

```
508178.322 CMAC_LOG_STATE_CHANGE                       maintenance_state
```

Benefits

The Cisco uBR900 series cable access router provides the following benefits for data-over-cable applications:

- Allows telecommuters and small office/home office customers to leverage the high-bandwidth, low-cost, IP-based data and voice services offered by cable service providers
- Enables the cost-effective deployment of advanced routing capabilities to the small office or home office site
- Prioritizes voice traffic ahead of data traffic, ensuring quality of service (QoS) over a shared cable infrastructure
- Leverages Cisco's industry-standard routing hardware and Cisco IOS software to deliver advanced networking services and applications such as virtual private networks (VPNs), support for multi-protocol networks, firewall security, and the ability to cost-effectively deploy local area networks (LANs)

Restrictions

When using the Cisco uBR900 series cable access router, keep the following restrictions and limitations in mind:

- The Cisco uBR900 series is able to implement multiples classes of service (CoS) on the cable interface; however, separate CoS streams are only available when the cable access router is connected to a headend that supports multiple CoS per cable access router. In addition, the configuration file downloaded to the cable access router must specify the use of multiple CoS.
- If the Cisco uBR900 series is connected to a DOCSIS 1.0 headend that does not support multiple CoS per cable access router, voice and data will be mixed, and voice traffic will be transmitted on a best effort basis. This may cause poorer voice quality and lower data throughput when calls are being made from the cable access router's telephone ports. Voice quality is also affected when transmitting or downloading large files, as well as by other significant network traffic.

Note The Cisco uBR900 series cable access router is typically configured by the headend CMTS. Most cable service providers do not permit local configuration by individual subscribers.

Caution Before attempting to reconfigure a Cisco uBR900 series cable access router at a subscriber site, contact your network administrator, provisioning manager, or billing system administrator to ensure remote configuration is allowed. If remote configuration is disabled, settings you make and save at the local site will not remain in effect after the cable access router is powered off and back on. Instead, settings will return to the previous configuration.

Related Features and Technologies

The Cisco uBR900 series cable access router is intended to be used in conjunction with a Cisco uBR7246 or a Cisco uBR7223 universal broadband router located at the cable service provider's headend facility. Other compatible headend devices may also be used with the Cisco uBR900 series.

Related Documents

For related information on the Cisco uBR900 series cable access router, refer to the following documents:

- *Quick Start Guide - Cisco uBR924 Cable Access Router Subscriber Setup*
- *Quick Start Guide - Cisco uBR924 Cable Access Router Installation and Startup*
- *Cisco uBR924 Installation and Configuration Guide*
- *Regulatory Compliance and Safety Information for the Cisco uBR924 Cable Access Router*
- *Cisco uBR7200 Series Installation and Configuration Guide*
- Cisco uBR7200 Series Configuration Notes
- *Cisco Network Registrar for the uBR7200 Series*
- *Regulatory Compliance and Safety Information for the Cisco uBR7200 Series Universal Broadband Router*
- *Cisco uBR7246 Universal Broadband Router Features*
- *Cisco uBR7246 Universal Broadband Router Feature Enhancements*

Supported Platforms

The Cisco uBR900 series cable access router is a standalone device; it works in conjunction with the Cisco uBR7246 and the Cisco uBR7223 universal broadband routers.

Prerequisites

In order to use the Cisco uBR900 series cable access router for data-over-cable or voice-over-cable (VoIP) applications, the following tasks must be completed:

- All required CMTS routing and network interface equipment must be installed, configured, and operational. This includes all headend routers, servers (DHCP, TFTP and TOD), network management systems, and/or other configuration or billing systems in use in your network.
- Based on the quality and capacity of your cable plant, your system administrator or network planner must define your network's IP address allocation plan; spectrum management plan outlining the recommended operating parameters to optimize performance; channel plan identifying the channels available to assign to specific Cisco uBR900 series cable access routers; and dial plan based on the supported VoIP protocol.
- The CMTS system administrator or appropriate personnel must specify the policy parameters for the Cisco uBR900 series and all computers and other customer premises devices to be supported at subscriber sites. Refer to Cisco's Network Registrar (CNR) product documentation.
- The CMTS system administrator or appropriate personnel must define and push DHCP and Cisco uBR900 series configuration files to the appropriate servers such that each cable access router, when initialized, can transmit a DHCP request, receive its IP address, obtain its TFTP and TOD server addresses, and download its configuration file (and updated Cisco IOS image, if required).

Note The MAC address on the cable access router ensures that each router downloads only the file(s) intended for it.

- The Cisco uBR900 series cable access router must be physically installed and cabled as follows:
  - To the headend via CATV coaxial cable. (High-quality, shielded RF coaxial cable with at least 80% braid is recommended.)
  - To at least one PC via the straight-through yellow Ethernet cable supplied with the cable access router. Refer to the appropriate cable access router quick start guide for detailed information.

Note When the Cisco uBR900 series is connected to an Ethernet hub, a crossover cable must be used. Category 5 UTP (10BaseT Ethernet) cable with RJ-45 connectors is recommended.

Note For subscriber sites that support multiple telephones or fax devices on a telephone line, all wiring associated with the telephone line extension must be in place. Inside wiring must be in compliance with the country of operation to prevent degradation of service.

- The CMTS system administrator must ensure appropriate databases are updated to activate and support the new subscriber account in the provisioning, billing and/or network management systems in place for your network once each cable access router is registered with the CMTS.
- The PC(s) connected to the Cisco uBR900 series cable access router must be configured for IP.
- Cisco IOS Release 11.3(4)NA or later must be running on the Cisco uBR900 series cable access router. When the cable access router is up and running, you can display the Cisco IOS release number by entering the **show version** command from user EXEC mode.

Note If the Cisco uBR7246 universal broadband router at the cable headend is using MC16 modem cards, Cisco IOS Release 11.3(7)NA or later must be running on the Cisco uBR900 series cable access router.

In order to use the Cisco uBR900 series cable access router for VoIP-over-cable applications, the following additional conditions must be met:

- In order to run VoIP Fax, the uBR900 series cable access router must be configured for voice and you must be using Cisco IOS Release 12.0(5)T or higher.

Supported MIBs and RFCs

The Cisco uBR900 series cable access router supports the following categories of MIBs:

- SNMP standard MIBs—These are the MIBs required by any agent supporting SNMPv1 or SNMPv2 network management. Specific MIBs in this category include:
  - CISCO-PRODUCT-MIB
  - CISCO-CHASSIS-MIB
  - CISCO-SYSLOG-MIB
  - CISCO-FLASH-MIB
  - BRIDGE-MIB
  - IF-MIB
  - CiscoWorks/CiscoView
- The Cisco Voice MIBs consist of the following components:
  - VOICE-IF-MIB
  - VOICE-DIAL-CONTROL-MIB
  - VOICE-ANALOG-MIB
  - DIAL-CONTROL-MIB
  - CISCO-DIAL-MIB
  - SGCP-MIB
- Cisco’s platform and network-layer enterprise MIBs—These MIBs are common across most of Cisco’s router platforms. If your network management applications are already configured to support other Cisco routers, such as the Cisco 2600 series or Cisco 7200 series, no further configuration is needed unless the version of Cisco IOS software being used has updated these MIBs.

- Cable-specific MIBs—These MIBs provide information about the cable interface and related information on the Cisco uBR900 series cable access router. They include both DOCSIS-required MIBs and Cisco-specific enterprise MIBs. If your network management applications have not already been configured for the Cisco uBR900 series cable access router, these MIBs must be loaded.

Cable-Specific MIBs

Table 4 shows the cable-specific MIBs that are supported on the Cisco uBR900 series cable access router. This table also provides a brief description of each MIB's contents and the Cisco IOS software release in which the MIB was initially functional—earlier releases might have had unsupported prototype versions of the MIB; later releases might have added new attributes and functionality. Because of interdependencies, the MIBs must be loaded in the order given in the table.

Note The names given in Table 4 are the filenames for the MIBs as they exist on Cisco's FTP site (ftp://ftp.cisco.com/pub/mibs/ or http://www.cisco.com/public/mibs). Most MIBs are available in both SNMPv1 and SNMPv2 versions; the SNMPv1 versions have *V1SMI* as part of their filenames.

Table 4 Supported MIBs for the Cisco uBR900 Series Cable Access Router

MIB Filename	Description	Release
SNMPv2-SMI.my SNMPv2-SMI-V1SMI.my	Specifies the Structure of Management Information (SMI) for SNMPv2, as defined in RFC 1902.	12.0(4)XI
SNMPv2-TC.my SNMPv2-TC-V1SMI.my	Defines the textual conventions as specified in pages 4, 10-11 of RFC 854.	12.0(4)XI
CISCO-SMI.my CISCO-SMI-V1SMI.my	Specifies the Structure of Management Information (SMI) for Cisco's enterprise MIBs.	12.0(4)XI
CISCO-TC.my CISCO-TC-V1SMI.my	Defines the textual conventions used in Cisco's enterprise MIBs.	12.0(4)XI
IF-MIB.my IF-MIB-V1SMI.my	Describes generic objects for the Layer 3 network interface sublayers. This MIB is an updated version of MIB-II's *if* table, and incorporates the extensions defined in RFC 1229.	12.0(4)XI
CISCO-CABLE-SPECTRUM-MIB.my CISCO-CABLE-SPECTRUM-MIB-V1SMI.my	Describes the spectrum management flap list attributes.	12.0(5)T1
DOCS-IF-MIB.my DOCS-IF-MIB-V1SMI.my	Describes the DOCSIS-compliant Radio Frequency (RF) interfaces in cable modems and cable modem termination systems. (This MIB is being updated on a release basis to add RFC2670 support as needed.)	12.0(4)XI
DOCS-BPI-MIB.my	Describes the attributes for the DOCSIS-specified Baseline Privacy Interface (BPI) on cable modems and the CMTS (available in an SNMPv2 version only).	12.0(5)T
CISCO-DOCS-EXT-MIB.my CISCO-DOCS-EXT-MIB-V1SMI.my	Extends the DOCSIS standard RFI MIB (DOCS-IF-MIB) with Cisco-specific extensions, such as QoS attributes and connection status and other information regarding the cable modems and CPE devices supported by the CMTS.	partial support: 12.0(4)XI full support: 12.0(5)T1
CABLE-DEVICE-MIB.my CABLE-DEVICE-MIB-V1SMI.my	Contains generic cable-related objects for DOCSIS-compliant cable modems.	12.0(4)XI

Table 4 Supported MIBs for the Cisco uBR900 Series Cable Access Router (continued)

MIB Filename	Description	Release
CISCO-CABLE-MODEM-MIB.my	Contains the Cisco enterprise objects for DOCSIS-compliant cable modems (available in an SNMPv2 version only).	12.0(4)XI
DOCS-CABLE-DEVICE-MIB	DOCSIS-specified MIB for DOCSIS-compliant cable modems (available in an SNMPv2 version only).	12.0(4)XI

The Cisco uBR900 series cable access router also supports the following:

- Radio Frequency Interface Specification—Developed by the Multimedia Cable Network System (MCNS) consortium. This is the radio-frequency interface specification for high-speed data-over-cable systems.
- CiscoWorks—Network management program for planning, troubleshooting, and monitoring Cisco internetworks. CiscoWorks uses Simple Network Management Protocol (SNMP) to monitor all SNMP devices.
  - For more information about CiscoWorks on CCO, follow this path: **Products & Ordering: Cisco Products: Network Management: CiscoWorks**
  - For more information about CiscoWorks on the Documentation CD-ROM, follow this path: **Cisco Product Documentation: Network Management: CiscoWorks**
- Radio Frequency Interface (RFI) MIB—Specific to DOCSIS cable implementations. The RIF MIB provides an interface that permits management of the Cisco uBR900 series cable access router over the cable or Ethernet interface. Using SNMP management applications, this MIB allows access to statistics such as MAC, driver configuration, and counters. The Cable Device MIB is very similar to the RFI MIB in that both allow access to statistics; they are different in that the Cable Device MIB reports statistics on the cable access router, while the RFI MIB reports statistics on the radio frequency transmissions over the cable television line.
- Simple Gateway Control Protocol (SGCP) MIB—Supports configuration, performance, and fault management of the SGCP interface. The SGCP MIB components are as follows:
  - **xgcplnBadVersions**—Number of incoming messages delivered to the protocol entity and that are for an unsupported protocol version
  - **xgcpRequestTimeOut**—Timeout value used for retransmitting an unacknowledged message
  - **xgcpRequestRetries**—Number of retries for a request that exceeds timeout
  - **xgcpAdminStatus**—Desired state of the protocol entity
  - **xgcpOperStatus**—Current operational status of the protocol entity
  - **xgcpUnRecognizedPackets**—Number of unrecognized packets since reset
  - **xgcpMsgStatTable**—Table that contains SGCP statistics information since reset
  - **xgcpMsgStatEntry**—Row in the xgcpMsgStatTable that contains information about SGCP message statistics per IP address of the Media Gateway Controller (MGC)
  - **xgcpIPAddress**—IP address of the MGC
  - **xgcpSuccessMessages**—Number of successful messages that communicate with the MGC on that IP address
  - **xgcpFailMessages**—Number of failed messages that communicate with the MGC on that IP address

— **xgcpUpDownNotification**—Notification sent when the protocol status changes between up and down

For descriptions of supported MIBs and how to use MIBs, see Cisco's MIB web site on CCO at http://www.cisco.com/public/sw-center/netmgmt/cmtk/mibs.shtml.

Configuration Tasks

The Cisco uBR900 series cable access router typically is configured automatically on power-up using a configuration file generated by the cable service provider and delivered via the CMTS installed at the cable headend. All of the configuration tasks listed below are optional.

- Configuring a Host Name and Password on page 37
- Configuring Ethernet and Cable Access Router Interfaces on page 38
- Configuring Routing on page 39
- Configuring Bridging on page 41
- Reestablishing DOCSIS-Compliant Bridging on page 43
- Customizing the Cable Access Router Interface on page 44
- Using Multiple PCs with the Cable Access Router on page 45

Caution Before attempting to reconfigure a Cisco uBR900 series cable access router at a subscriber site, contact your network administrator, provisioning manager, or billing system administrator to ensure remote configuration is allowed. If remote configuration is disabled, settings you make and save at the local site will not remain in effect after the cable access router is powered off and back on. Instead, settings will return to the previous configuration.

Note Console sessions and TTY sessions are supported by the cable access router.

Configuring a Host Name and Password

One of the first configuration tasks you might want to perform is to configure a host name and set an encrypted password. Configuring a host name allows you to distinguish multiple Cisco uBR900 series cable access routers from each other. Setting an encrypted password allows you to prevent unauthorized configuration changes.

Note Passwords are case sensitive.

To configure a host name and an encrypted password for a Cisco uBR900 series cable access router, perform the following tasks, starting in global configuration mode:

Step	Command	Purpose
1	`uBR924(config)# hostname cisco` `cisco(config)#`	Change the name of the uBR900 series to a meaningful name. Substitute your host name for **cisco**.
2	`cisco(config)# enable secret guessme`	Enter an enable secret password. This password provides access to enable (privileged EXEC) mode. After configuring a password, when you enter **enable** at the EXEC prompt, you must enter the enable secret password to gain access to configuration mode. Substitute your enable secret password for **guessme**.
3	`cisco(config)# line console 0`	Enter line configuration mode to configure the console port.
	`cisco(config-line)# exec-timeout 0 0`	Prevent the EXEC facility from timing out if you do not type any information on the console screen for an extended period.
	`cisco(config-line)# exit` `cisco(config)#`	Exit back to global configuration mode.

Verifying the Host Name and Password

To verify that you configured the correct host name and password, enter the **show running-config** command from global configuration mode:

```
cisco(config)# show running-config
Using 1888 out of 126968 bytes
!
version XX.X
.
.
!
hostname cisco
!
enable secret 5 $1$60L4$X2JYOwoDc0.kqa1loO/w8/
```

- Check the host name and encrypted password displayed near the top of the command output.

- Exit global configuration mode and attempt to reenter it using the new enable password:

```
cisco# exit

cisco con0 is now available
Press RETURN to get started.
cisco> enable
Password: guessme
cisco#
```

Configuration, Verification, and Troubleshooting Tips

If you are having trouble:

- Make sure **Caps Lock** is off.
- Make sure you entered the correct passwords. Passwords are case sensitive.

Configuring Ethernet and Cable Access Router Interfaces

To assign an IP address to the Ethernet or cable access router interface so that it can be recognized as a device on the Ethernet LAN, perform the following tasks, starting in global configuration mode:

Step	Command	Purpose

1	`uBR924(config)# interface ethernet 0`
	
	or
	
	`uBR924(config)# interface modem-cable0`
	
	`uBR924(config-if)#`
		Enter interface configuration mode for the Ethernet and/or the cable access router interface.

2	`uBR924(config-if)# ip address 172.16.1.1 255.255.255.0`	Assign the appropriate IP address and subnet mask to the interface.

3	`uBR924(config-if)# Ctrl-Z`
	`uBR924#`
	
	`%SYS-5-CONFIG_I: Configured from console by console`
		Return to privileged EXEC mode.
		
		This message is normal and does not indicate an error.

Verifying IP Address Configuration

To verify that you have assigned the correct IP address, enter the **show arp** command:

```
uBR924# show arp
Protocol  Address     Age (min)  Hardware Addr   Type   Interface
Internet  172.16.1.1        -    0009.0613.6030  ARPA   cable-modem0
Internet  4.0.0.28          -    00e0.1ed7.524d  ARPA   Ethernet0
```

Configuration, Verification, and Troubleshooting Tips

If you are having trouble:

- Make sure you are using the correct IP address.
- Make sure the cable interface is not shut down. Use the **show running-config** command to check the cable interface status.

Configuring Routing

DOCSIS-compliant transparent bridging is the factory default configuration of the Cisco uBR900 series cable access router. To change the configuration of your cable access router from bridging to routing using the CLI, perform the following tasks, starting in global configuration mode:

Step	Command	Purpose
1	uBR924(config)#**interface cable-modem0**	Enter interface configuration mode for the cable access router interface.
2	uBR924(config-if)#**no cable-modem compliant bridge** uBR924(config-if)#**no bridge-group 59** uBR924(config-if)#**end**	Turn off DOCSIS-compliant bridging. Remove the default bridge group assignment from the cable interface. Return to global configuration mode.
3	uBR924(config)#**ip routing** uBR924(config)#**ip subnet-zero** uBR924(config)#**ip route** *<IP address of CMTS> <subnet mask of CMTS>*	Enable IP routing for the cable access router. Enable the use of subnet zero for interface addresses and routing updates. Create a static route to the CMTS to make sure that Time of Day (TOD) packets are properly routed out of the cable access router.
4	uBR924(config)#**router rip**	Enter router configuration mode and enable Routing Information Protocol (RIP) on the cable access router.
5	uBR924(config-router)#**network** *network-number*	Specify the network connected to the cable access router on which the RIP process will operate. If the cable access router is attached to more than one network, enter each IP address in a separate command.
6	uBR924(config-router)#**end** uBR924(config)#**interface cable-modem0**	Exit router configuration mode. Return to interface configuration mode for the cable access router interface.
7	uBR924(config-if)#**ip rip receive v 2**	Specify that only RIP Version 2 packets will be received on the coaxial cable interface.
8	uBR924(config-if)#**ip rip send v 2**	Specify that only RIP Version 2 packets will be sent on the coaxial cable interface.
9	uBR924(config-if)#**end** uBR924(config)#**interface ethernet0**	Exit interface configuration mode for the cable access router interface and enter interface configuration mode for the Ethernet0 interface.
10	uBR924(config-if)#**no bridge-group 59**	Remove the default bridge group assignment from the Ethernet0 interface.
11	uBR924(config-if)#**ip rip receive v 2**	Specify that only RIP Version 2 packets will be received on this Ethernet interface.
12	uBR924(config-if)#**ip rip send v 2**	Specify that only RIP Version 2 packets will be sent on this Ethernet interface.
13	uBR924(config-if)#**Ctrl-z** uBR924#**copy running-config startup-config** Building configuration...	Return to privileged EXEC mode. Save the configuration to nonvolatile RAM so that it won't be lost in the event of a reset, power cycle, or power outage.

Verifying Routing

To verify that bridging is not configured, routing is enabled, and that Routing Information Protocol is configured on the interfaces, enter the **show startup-config** command:

```
uBR924# show startup-config
Building configuration...

Current configuration:
!
version 12.0
no service pad
no service password-encryption
service udp-small-servers
service tcp-small-servers
!
hostname uBR924
!
!
clock timezone - 4
ip subnet-zero
!
!
!
voice-port 0
!
voice-port 1
!
!
interface Ethernet0
 ip address 10.1.0.33 255.255.0.0
 no ip directed-broadcast
 ip rip send version 2
 ip rip receive version 2
 no keepalive
!
interface cable-modem0
 ip address 172.16.1.42 255.255.0.0
 no ip directed-broadcast
 ip rip send version 2
 ip rip receive version 2
 no keepalive
cable-modem downstream saved channel 699000000 39
 no cable-modem compliant bridge
 !
router rip
 network 4.0.0.0
 network 172.16.0.0
!
ip classless
no ip http server
!
line con 0
 transport input none
line vty 0 4
 !
end
```

Configuring Bridging

The Cisco uBR900 series cable access router is configured for DOCSIS-compliant transparent bridging by default. If it becomes necessary to *reconfigure* the unit for bridging after it has been configured for routing, you can erase the routing configuration and return the unit to factory default configuration settings, or you can reconfigure the unit manually using the CLI. To return the cable access router to factory default settings, see the section "Reestablishing DOCSIS-Compliant Bridging" on page 43 for details. To reconfigure the cable access router manually, perform the following tasks, starting in global configuration mode:

Step	Command	Purpose
1	`uBR924(config)#no service pad`	Disable packet assembler/disassembler commands; prevent the uBR900 series from accepting incoming or outgoing Packet Assembler/Disassembler (PAD) connections.
2	`uBR924(config)#no service password-encryption`	Disable password encryption.
3	`uBR924(config)#no ip routing`	Disable IP routing on the uBR900 series.
4	`uBR924(config)#interface Ethernet0`	Enter interface configuration mode for the Ethernet0 interface.
5	`uBR924(config-if)#no ip address`	Disable the IP address on the Ethernet0 interface.
6	`uBR924(config-if)#no ip route-cache`	Disable high-speed switching caches for IP routing.
7	`uBR924(config-if)#bridge-group` *bridge-group*	Assign the Ethernet0 interface to a bridge group. The bridge group must be an integer between 1 and 63.
8	`uBR924(config-if)#bridge-group` *bridge-group* `spanning-disabled`	Disable spanning tree on the Ethernet interface.
9	`uBR924(config-if)#end` `uBR924(config)#interface cable-modem0`	Exit interface configuration mode for the Ethernet0 interface and enter interface configuration mode for the cable access router interface.
10	`uBR924(config-if)#no ip address`	Disable the IP address of the coaxial cable interface, if one has been set. The uBR7246 cable router assigns an IP address to the cable access router each time it connects to the network.
11	`uBR924(config-if)#no ip route-cache`	Disable high-speed switching caches for IP routing on the cable interface.
12	`uBR924(config-if)#no keepalive`	Disable keepalives on the cable interface.
13	`uBR924(config-if)#cable-modem compliant bridge`	Enable DOCSIS-compliant bridging.
14	`uBR924(config-if)#bridge-group` *bridge-group*	Assign the cable access router interface to a bridge group. The bridge group must be an integer from 1 to 63. (The default is 59.)
15	`uBR924(config-if)#bridge-group` *bridge-group* `spanning-disabled`	Disable spanning tree on the cable interface.
16	`uBR924(config-if)#end` `uBR924(config)#ip classless`	Exit interface configuration mode. (Optional) At times, the uBR900 series might receive packets destined for a subnet of a network that has no network default route. This global configuration mode command allows the Cisco IOS software to forward such packets to the best network route possible.
17	`uBR924(config)#line console 0`	Enter line configuration mode to configure the console port.

Step	Command	Purpose
18	uBR924(config-line)#**line vty 0 4**	Identify the last line in a contiguous group of virtual terminals you want to configure.
19	uBR924(config-line)#**Ctrl-z** uBR924#**copy running-config startup-config** Building configuration...	Return to privileged EXEC mode. Save the configuration to nonvolatile RAM so that it won't be lost in the event of a reset, power cycle, or power outage.

When the cable interface comes up, the IP address and downstream channel are configured automatically.

Note To configure multiple PCs, repeat Steps 4 through 7 above for each additional PC. You can connect a maximum of three PCs to the Cisco uBR900 series cable access router in a bridging application.

Verifying Bridging

To verify that routing has been disabled on all interfaces and that bridging has been reenabled, enter the **show startup-config** command from privileged EXEC mode:

```
uBR924# show startup-config
Building configuration...
Current configuration:
!
version 12.0
service config
no service pad
service timestamps debug uptime
service timestamps log uptime
no service password-encryption
!
hostname uBR924
!
clock timezone - 4
ip subnet-zero
no ip routing
!
!
voice-port 0
!
!
voice-port 1
!
!
interface Ethernet0
 no ip address
 no ip directed-broadcast
 no ip route-cache
 bridge-group 59
 bridge-group 59 spanning-disabled
!
```

```
interface cable-modem0
 no ip address
 no ip directed-broadcast
 no ip route-cache
 no keepalive
 cable-modem downstream saved channel 699000000 36
 bridge-group 59
 bridge-group 59 spanning-disabled
!
ip classless
!
line con 0
line vty 0 4
 login
!
end
```

Reestablishing DOCSIS-Compliant Bridging

To erase the current non-default cable access router configuration and return the unit to its factory default DOCSIS-compliant bridging configuration, perform the following task from privileged EXEC mode:

Step	Command	Purpose
1	uBR924#**erase startup config**	Erase the current configuration (assuming the current running configuration has been saved to NVRAM).

After entering this command, perform a warm reset of the Cisco uBR900 series cable access router by pressing and holding down the Reset button for less than 10 seconds. For information on the location and operation of the Reset button, refer to the “Physical Description” section in the chapter “Installing the Cisco uBR924 Cable Access Router” in the *Cisco uBR924 Cable Access Router Installation and Configuration Guide*.

Verifying DOCSIS-Compliant Bridging

To verify that the cable access router is configured for DOCSIS-compliant bridging, enter the **show startup-config** command from privileged EXEC mode. The configuration should look like this:

```
uBR924# show startup-config
Building configuration...
Current configuration:
!
version 12.0
service config
no service pad
service timestamps debug uptime
service timestamps log uptime
no service password-encryption
!
hostname uBR924
!
clock timezone - 4
ip subnet-zero
no ip routing
!
!
!
```

```
voice-port 0
!
!
voice-port 1
!
!
interface Ethernet0
 no ip address
 no ip directed-broadcast
 no ip route-cache
 bridge-group 59
 bridge-group 59 spanning-disabled
!
interface cable-modem0
 no ip address
 no ip directed-broadcast
 no ip route-cache
 no keepalive
 cable-modem downstream saved channel 699000000 36
 bridge-group 59
 bridge-group 59 spanning-disabled
!
ip classless
no ip http server
!
line con 0
 transport input none
line vty 0 4
 login
!
end
```

Customizing the Cable Access Router Interface

Different geographical regions and different cable plants use different frequency bands. The Cisco uBR900 series cable access router uses a built-in default frequency scanning feature to address this issue. After the cable access router finds a successful downstream frequency channel, it saves the channel and power setting to NVRAM. The cable access router recalls this value the next time it needs to synchronize its frequency or register with the cable service provider's CMTS.

However, you can customize the cable access router's interface configuration if you need to deviate from the default setting that ships with the unit. For example, you might need to specify a different compliant mode, modify the saved downstream channel setting and upstream power value, or enable a faster downstream search algorithm.

Note Most cable network scenarios will not require you to use these commands.

To customize the cable access router interface, perform the following tasks, starting in global configuration mode:

Step	Command	Purpose
1	`uBR924(config)#`**`interface cable-modem 0`**	Specify cable access router interface 0.
2	`uBR924(config-if)#`**`cable-modem compliant bridge`**	Enable DOCSIS-compliant bridging.

Step	Command	Purpose
3	`uBR924(config-if)#`**`cable-modem downstream saved channel`** *`ds-frequency us-power`*	Modify the saved downstream channel setting and upstream power value. If you do this, you must specify an exact downstream frequency and a power value.[1]
4	`uBR924(config-if)#`**`cable-modem fast-search`**	Enable a faster downstream search algorithm.

1Use the **no cable-modem downstream saved channel** *ds-frequency us-power* command to remove a saved frequency and power setting from NVRAM.

Using Multiple PCs with the Cable Access Router

The MAX CPE parameter in the DOCSIS configuration file determines how many PCs or other CPE devices are supported by a particular cable access router. The default value for the MAX CPE parameter is 1, which means only one PC can be connected to the cable access router unless this value is changed.

The DOCSIS 1.0 specification states that a CMTS cannot age-out MAC addresses for CPE devices. Thus, if MAX CPE = 1, the first PC that is connected to a cable access router is normally the only one that the CMTS recognizes as valid. If you wish to replace an existing PC or change its network interface card (NIC) to one that has a different MAC address, the CMTS will refuse to let the PC come online because this would exceed the maximum number of CPE devices specified by the MAX CPE parameter.

If you wish to replace an existing PC or NIC, use one of the following workarounds:

- Use the **clear cable host mac address reset** command on the Cisco uBR7200 series router to remove the PC's MAC address from the router's internal address tables. The PC's MAC address will be rediscovered and associated with the correct cable access router during the next DHCP lease cycle.
- Power off the cable access router for approximately one minute and then power it back on so that the PC's MAC address will be rediscovered and associated with the cable access router during the normal provisioning process. The PC might also have to be rebooted.
- Increase the value of the MAX CPE parameter in the cable access router's DOCSIS configuration file so that it can accommodate the desired number of PCs. Reset the cable access router to force it to load the updated configuration file.

Configuration Examples

This section provides the following configuration examples:

- Basic Internet Access Bridging Configuration on page 46
- Basic Internet Access Routing Configuration on page 47
- Multicast-Enabled Routing Configuration on page 48
- VoIP Bridging Configuration Using H.323v2 on page 49
- VoIP Routing Configuration Using H.323v2 on page 50
- NAT/PAT Configuration on page 51
- VoIP Bridging Configuration Using SGCP on page 52
- IPSec Configuration on page 53
- L2TP Configuration on page 54

Basic Internet Access Bridging Configuration

The following Cisco uBR900 series cable access router configuration supports a typical residential Internet-access, data only subscriber:

```
Current configuration:
!
version 12.0
service config
no service pad
service timestamps debug uptime
service timestamps log uptime
no service password-encryption
!
hostname uBR924
!
clock timezone - 4
ip subnet-zero
no ip routing
!
voice-port 0
!
voice-port 1
!
interface Ethernet0
 ip address 172.16.1.40 255.255.0.0
 no ip directed-broadcast
 no ip route-cache
 bridge-group 59
 bridge-group 59 spanning-disabled
!
interface cable-modem0
 ip address 172.16.1.40 255.255.0.0
 no ip directed-broadcast
 no ip route-cache
 cable-modem downstream saved channel 699000000 36
 bridge-group 59
 bridge-group 59 spanning-disabled
!
ip classless
no ip http server
!
```

```
line con 0
 transport input none
line vty 0 4
 login
!
end
```

Basic Internet Access Routing Configuration

The Cisco uBR900 series cable access router can be configured to act as a router to preserve IP address space and limit broadcasts that can impact the performance of the network. A sample configuration file follows.

Note To configure the Cisco uBR900 series to act as a router, the **no cable-modem compliant bridge** command must be used. In addition, the **bridge group 59** command must be removed from the Ethernet and cable-modem interfaces.

```
Current configuration:
!
version 12.0
service config
no service pad
service timestamps debug uptime
service timestamps log uptime
no service password-encryption
!
hostname uBR924
!
clock timezone - 4
ip subnet-zero
!
voice-port 0
!
voice-port 1
!
interface Ethernet0
 ip address 10.1.0.33 255.255.0.0
 no ip directed-broadcast
 !
interface cable-modem0
 ip address 172.16.1.42 255.255.0.0
 no ip directed-broadcast
 cable-modem downstream saved channel 699000000 39
 no cable-modem compliant bridge
 !
router rip
 network 4.0.0.0
 network 172.16.0.0
!
ip classless
no ip http server
!
line con 0
 transport input none
line vty 0 4
 !
end
```

Multicast-Enabled Routing Configuration

The following configuration is for a Cisco uBR900 series that uses PIM sparse-dense mode and belongs to a specific multicast group. Other multicast routing protocols such as PIM sparse-mode or PIM dense-mode can be used.

```
Current configuration:
!
! Last configuration change at 23:16:44 - Thu Mar 18 1999
!
version 12.0
service config
no service pad
service timestamps debug uptime
service timestamps log uptime
no service password-encryption
!
hostname uBR924
!
clock timezone - 4
ip subnet-zero
!
ip multicast-routing
ip dvmrp route-limit 20000
!
voice-port 0
!
voice-port 1
!
interface Ethernet0
 ip address 24.1.0.1 255.255.0.0
 no ip directed-broadcast
 ip pim sparse-dense-mode
 no ip route-cache
 no ip mroute-cache
!
interface cable-modem0
 ip address 10.1.0.25 255.255.0.0
 no ip directed-broadcast
 ip pim sparse-dense-mode
 no ip route-cache
 no ip mroute-cache
 cable-modem downstream saved channel 477000000 56
 no cable-modem compliant bridge
!
!
router rip
 version 2
 network 24.0.0.0

network 10.0.0.0
!
!
ip classless
no ip http server
!
!
line con 0
 transport input none
line vty 0 4
!
end
```

VoIP Bridging Configuration Using H.323v2

In this example, the Cisco uBR900 series is configured for bridging, with an H.323v2 dial peer to another Cisco uBR900 series attached to the same downstream interface on the headend CMTS.

```
Current configuration:
!
! Last configuration change at 21:54:41 - Thu Apr 29 1999
! NVRAM config last updated at 21:56:20 - Thu Apr 29 1999
!
version 12.0
no service pad
service timestamps debug uptime
service timestamps log uptime
no service password-encryption
!
hostname 2007
!
clock timezone - 3
ip subnet-zero
no ip routing
!
voice-port 0
 input gain -3
!
voice-port 1
 input gain -3
!
dial-peer voice 1 pots
 destination-pattern 6501
 port 0
!
dial-peer voice 2 pots
 destination-pattern 6502
 port 1
!
dial-peer voice 62 voip
 destination-pattern 620.
 session target ipv4:10.1.71.62
!
interface Ethernet0
 ip address 10.1.71.65 255.255.255.0
 no ip directed-broadcast
 no ip route-cache
 bridge-group 59
 bridge-group 59 spanning-disabled
!
interface cable-modem0
 description DHCP Reserved Address 10.1.71.65
 ip address 10.1.71.65 255.255.255.0
 no ip directed-broadcast
 no ip route-cache
 cable-modem downstream saved channel 537000000 27
 bridge-group 59
 bridge-group 59 spanning-disabled
!
ip classless
no ip http server
!
line con 0
 exec-timeout 0 0
 transport input none
line vty 0 4
 login
end
```

VoIP Routing Configuration Using H.323v2

In this example, the Cisco uBR900 series is configured for IP routing, with an H.323v2 dial peer to another Cisco uBR900 series attached to the same downstream interface on the headend CMTS.

```
Current configuration:
!
! No configuration change since last restart
!
version 12.0
no service pad
service timestamps debug uptime
service timestamps log uptime
no service password-encryption
!
hostname 2007
!
class-map class-default
  match any
!
clock timezone - 3
ip subnet-zero
!
voice-port 0
!
voice-port 1
!
dial-peer voice 1 pots
 destination-pattern 6101
 port 0
!
dial-peer voice 2 pots
 destination-pattern 6102
 port 1
!
dial-peer voice 101 voip
 destination-pattern 620*
 codec g711alaw
 session target ipv4:10.1.71.62
!
interface Ethernet0
 ip address 24.1.61.1 255.255.255.0
 no ip directed-broadcast
 no ip mroute-cache
!
interface cable-modem0
 ip address 10.1.71.61 255.255.255.0
 no ip directed-broadcast
 no ip mroute-cache
 cable-modem downstream saved channel 537000000 27
 no cable-modem compliant bridge
!
router rip
 version 2
 network 10.0.0.0
 network 24.0.0.0
 no auto-summary  <<==== Not necessary
!
no ip classless
ip route 0.0.0.0 0.0.0.0 10.1.71.1
no ip http server
!
```

```
line con 0
 exec-timeout 0 0
 transport input none
line vty 0 4
 login
!
!
end
```

NAT/PAT Configuration

```
Current configuration:
!
! No configuration change since last restart
!
version 12.0
no service pad
service timestamps debug uptime
service timestamps log uptime
no service password-encryption
!
hostname uBR924
!
!
ip nat inside source list 1 interface cable-modem0 overload
clock timezone - -4
!
!
interface Ethernet0
 ip address 10.1.1.1 255.255.255.0
 ip nat inside
!
interface cable-modem0
 ip address 24.3.90.20 255.255.255.0
 ip nat outside
 no keepalive
 cable-modem downstream saved channel 627000000 54
 no cable-modem compliant bridge
!
ip default-gateway 24.3.90.2
ip classless
ip route 0.0.0.0 0.0.0.0 24.3.90.2
access-list 1 permit any
!
line con 0
line vty 0 4
 login
!
end
```

VoIP Bridging Configuration Using SGCP

In this example, Cisco uBR924 is configured to support VoIP in bridging mode using SGCP. Note the following in the sample configuration file:

- SGCP is enabled.
- The call agent IP address is specified.
- The SGCP application is specified for each port.

To configure this application via DHCP, the following fields must also be set:

- Host name
- Domain name
- Domain Name System (DNS) server
- Merit dump file — S:0:<call agen FQDN>:S:1<call agent FQDN>

```
Current configuration:
!
! Last configuration change at 16:30:00 - Thu Dec 16 1999
!
version 12.1
no service pad
service timestamps debug uptime
service timestamps log uptime
no service password-encryption
!
hostname art1
!
clock timezone - 0 6
ip subnet-zero
no ip routing
ip domain-name cisco.com
ip name-server 4.0.0.32
!
sgcp
!
xgcp snmp sgcp
!
!
voice-port 0
!
voice-port 1
!
dial-peer voice 100 pots
 application SGCPAPP
 port 0
!
dial-peer voice 101 pots
 application SGCPAPP
 port 1
!
process-max-time 200
!
interface Ethernet0
 ip address 188.186.1.14 255.255.0.0
 no ip directed-broadcast
 no ip route-cache
 no ip mroute-cache
 bridge-group 59
 bridge-group 59 spanning-disabled
```

```
!
interface cable-modem0
 ip address 188.186.1.14 255.255.0.0
 no ip directed-broadcast
 no ip route-cache
 no ip mroute-cache
 cable-modem downstream saved channel 699000000 27
 bridge-group 59
 bridge-group 59 spanning-disabled
!
ip classless
no ip http server
!
!
line con 0
 transport input none
line vty 0 4
 login
!
end
```

IPSec Configuration

Note Encryption/decryption is subject to export licensing controls. To support IPSec, the Cisco uBR900 series must be configured in routing mode. the software images running at both the headend and the subscriber end must support the feature set.

Note Careful address assignment on user equipment and policy routing at the headend is required. The headend may or may not use tunnels to convey traffic back to the corporate gateway.

For detailed information on IP security, L2TP, and Firewall, refer to the *Security Configuration Guide*.

```
Current configuration:
!
Last configuration change at 23:24:55 - Thu Dedc 16 1999
!
version 12.1
no service pad
service timestamps debug uptime
service timestamps log uptime
!
hostname Router
!
clock timezone - 0 6
ip subnet-zero
no ip domain-lookup
!
crypto isakmp policy 1
 hash md5
 authentication pre-share
 lifetime 5000
crypto isakmp key 1111 address 30.1.1.1
crypto isakmp identity hostname
!
```

```
crypto ipsec transform-set test-transform ah-md5-hmac esp-des esp-md5-hmac
!
 crypto map test-ipsec local-address cable-modem0
 crypto map test-ipsec 10 ipsec-isakmp
 set peer 30.1.1.1
 set transform-set test-transform
 match address 100
!
interface Ethernet0
 ip address 24.1.0.1 255.255.0.0
 no ip directed-broadcast
!
interface cable-modem0
 ip address 10.1.0.25 255.255.0.0
 no ip directed-broadcast
 no keepalive
 cable-modem downstream saved channel 213000000 30
 no cable-modem compliant bridge
crypto map test-ipsec
router rip
 version 2
 network 10.0.0.0
 network 24.0.0.0
!
ip classless
no ip http server
!
access-list 100 permit ip host 10.1.0.25 30.1.1.0 0.0.0.255
!
line con 0
 exec-timeout 0 0
 transport input none
line vty 0 4
 login
!
end
```

L2TP Configuration

Note Encryption/decryption is subject to export licensing controls. To support L2TP and Firewall, the Cisco uBR900 series must be configured in routing mode. Software images running at both the headend and the subscriber end must support the feature set.

Note Careful address assignment on user equipment and policy routing at the headend is required. The headend may or may not use tunnels to convey traffic back to the corporate gateway.

For detailed information on IP security, L2TP, and Firewall, refer to the *Security Configuration Guide.*

```
Current configuration:
!
! Last configuration change at 20:24:59 - Thu Dec 23 1999
! NVRAM config last updated at 20:34:52 - Thu Dec 23 1999
!
version 12.1
no service pad
service timestamps debug uptime
service timestamps log uptime
!
hostname Router
!
class-map class-default
  match any
!
!
clock timezone - 0 1
ip subnet-zero
ip tftp source-interface cable-modem0
no ip domain-lookup
!
vpdn enable
!
vpdn-group 1
 accept dialin l2tp virtual-template 1 remote L2TP_LAC
 no l2tp tunnel authentication
 !
 !
interface Ethernet0
 ip address 80.1.1.1 255.255.255.0
 no ip directed-broadcast
!
interface Virtual-Template1
 ip unnumbered Ethernet0
 no ip directed-broadcast
 peer default ip address pool dialup
 ppp authentication chap
!
interface cable-modem0
 ip address 255.255.0.0
 no ip directed-broadcast
 cable-modem downstream saved channel 639000000 38
no cable-modem compliant bridge
!
router rip
 version 2
 network 10.0.0.0
 network 24.0.0.0
!
ip local pool dialup 24.1.0.100
ip classless
no ip http server
!
line con 0
 transport input none
line vty 0 4
 login
!
end
```

Command Reference

This section describes the following cable-modem interface commands for the Cisco uBR900 series cable access router for Cisco IOS Release 12.0(7)T:

- **cable-modem compliant bridge**
- **cable-modem downstream saved channel**
- **cable-modem fast-search**
- **cable-modem upstream preamble qpsk**
- **cable-modem voip best-effort**
- **interface cable-modem**
- **show bridge cable-modem**
- **show controllers cable-modem**
- **show controllers cable-modem bpkm**
- **show controllers cable-modem des**
- **show controllers cable-modem filters**
- **show controllers cable-modem lookup-table**
- **show controllers cable-modem mac**
- **show controllers cable-modem phy**
- **show controllers cable-modem tuner**
- **show controllers cable-modem**
- **show interfaces cable-modem**

All commands relating to VoIP applications are documented in the Cisco IOS Release 12.0 command references, or in *Voice over IP for the Cisco AS5300*, which can be accessed online or on the Documentation CDROM by going to **New Features in Cisco IOS Release 12.0(3)T**.

All other commands used with this feature are documented in the Cisco IOS Release 12.0 command references.

In Cisco IOS Release 12.0(1)T or later, you can search and filter the output for **show** and **more** commands. This functionality is useful when you need to sort through large amounts of output, or if you want to exclude output that you do not need to see.

To use this functionality, enter a **show** or **more** command followed by the "pipe" character (|), one of the keywords **begin**, **include**, or **exclude**, and an expression that you want to search or filter on:

command **|** {**begin** | **include** | **exclude**} *regular-expression*

Following is an example of the **show atm vc** command in which you want the command output to begin with the first line where the expression "PeakRate" appears:

show atm vc | begin PeakRate

For more information on the search and filter functionality, refer to the Cisco IOS Release 12.0(1)T document, *CLI String Search*.

cable-modem compliant bridge

To enable DOCSIS-compliant transparent bridging for a cable access router interface at startup, use the **cable-modem compliant** command from interface configuration mode. Use the **no** form of this command to disable DOCSIS-compliant bridging for the interface.

cable-modem compliant bridge

no cable-modem compliant bridge

Syntax Description

This command has no arguments or keywords.

Defaults

Enabled

Command Modes

Interface configuration

Command History

Release	Modification
11.3 NA	This command was introduced.

Usage Guidelines

It is normally not necessary to enter this command in data-over-cable bridging applications because DOCSIS-compliant bridging is enabled by default. If you wish to do full transparent bridging rather than DOCSIS-compliant bridging, use the **no** form of the command, then configure full transparent bridging using CLI commands. See the "Configuring Bridging" section on page 41 for instructions.

Examples

The following example shows how to enter the **cable-modem compliant bridge** command for a cable access router interface, starting from global configuration mode:

```
uBR924(config)# interface cable-modem 0
uBR924(config-if)# cable-modem compliant bridge
uBR924(config-if)#
```

Related Commands

Command	Description
cable-modem downstream saved channel	Modifies the saved downstream channel setting and upstream power value on the cable interface of a Cisco uBR900 series.
cable-modem fast-search	Enables a faster downstream search algorithm on the cable interface of a Cisco uBR900 series.
cable-modem upstream preamble qpsk	Enables the QPSK modulation scheme in the upstream direction from the Cisco uBR900 series to the CMTS.
cable-modem voip best-effort	Allows voice traffic to be transmitted on the upstream via best effort rather than by assigning it a higher priority class of service.

cable-modem downstream saved channel

To modify the saved downstream channel setting and upstream power value on a cable access router interface, enter the **cable-modem downstream saved channel** command from interface configuration mode. Use the **no** form of this command to remove the saved settings, which will be resaved at the next initialization cycle.

cable-modem downstream saved channel *ds-frequency us-power*

no cable-modem downstream saved channel *ds-frequency us-power*

Syntax Description

ds-frequency	Downstream channel frequency in Hz, which can be from 91000000 to 860000000.
us-power	Upstream power level in decibels per millivolt (dBmV), which can be from 8 to 61.

Defaults

Enabled

Command Modes

Interface configuration

Command History

Release	Modification
11.3 NA	This command was introduced.

Usage Guidelines

This command is auto-generated by the operation of the cable MAC layer process. The DOCSIS RFI specification requires that cable modems remember the downstream frequency and upstream power of the last successfully ranged session. These parameters are called up as the first downstream frequency and upstream power to use the next time the cable modem is booted. This operation dramatically speeds up the channel search.

Use the **no cable-modem downstream saved channel** *ds-frequency us-power* command to remove the saved frequency and power setting from the running configuration, which will be resaved at the next initialization cycle.

Cisco recommends that this command NOT be used by end users of the Cisco uBR900 series cable access router.

Examples

The following example shows how to remove the downstream frequency of 91000000 Hz and the upstream power level of 33 dBmV from the running configuration of a cable-modem interface, starting from global configuration mode.

```
uBR924(config)# interface cable-modem 0
uBR924(config-if)# no cable-modem downstream saved channel 91000000 33
uBR924(config-if)#
```

Related Commands

Command	Description
cable-modem compliant bridge	Enables DOCSIS-compliant transparent bridging on the Cisco uBR900 series at startup.
cable-modem fast-search	Enables a faster downstream search algorithm on the cable interface of a Cisco uBR900 series.
cable-modem upstream preamble qpsk	Enables the QPSK modulation scheme in the upstream direction from the Cisco uBR900 series to the CMTS.
cable-modem voip best-effort	Allows voice traffic to be transmitted on the upstream via best effort rather than by assigning it a higher priority class of service.

cable-modem fast-search

To enable a faster downstream search algorithm on a cable access router interface, use the **cable-modem fast-search** command from interface configuration mode. Use the **no** form of this command to disable the downstream fast-search feature.

cable-modem fast-search

no cable-modem fast-search

Syntax Description

There are no keywords or arguments for this command.

Defaults

Disabled

Command Modes

Interface configuration

Command History

Release	Modification
11.3 NA	This command was introduced.

Usage Guidelines

This feature speeds up the frequency search performed by the cable access router. Normally it takes the cable access router about 30 to 50 seconds to sample 30 to 50 frequencies. The **cable-modem fast-search** command can reduce this search time. However, there might be some cases where this fast-search algorithm might not perform as well as the default algorithm. Trial and error is the only way to discover how well this feature works for your environment.

Examples

The following example shows how to enter the **cable-modem fast-search** command, starting from global configuration mode:

```
uBR924(config)# interface cable-modem 0
uBR924(config-if)# cable-modem fast-search
uBR924(config-if)#
```

Related Commands

Command	Description
cable-modem compliant bridge	Enables DOCSIS-compliant transparent bridging on the Cisco uBR900 series at startup.
cable-modem downstream saved channel	Modifies the saved downstream channel setting and upstream power value on the cable interface of a Cisco uBR900 series.
cable-modem upstream preamble qpsk	Enables the QPSK modulation scheme in the upstream direction from the Cisco uBR900 series to the CMTS.
cable-modem voip best-effort	Allows voice traffic to be transmitted on the upstream via best effort rather than by assigning it a higher priority class of service.

cable-modem upstream preamble qpsk

To enable the QPSK modulation scheme in the upstream direction from the cable access router interface to the headend, enter the **cable-modem upstream preamble qpsk** command from interface configuration mode. Use the **no** form of this command to disable upstream modulation for the interface.

cable-modem upstream preamble qpsk

no cable-modem upstream preamble qpsk

Syntax Description

This command has no arguments or keywords.

Defaults

Enabled

Command Modes

Interface configuration

Command History

Release	Modification
11.3 NA	This command was introduced.

Usage Guidelines

Examples

The following example shows how to enter the **cable-modem upstream preamble qpsk** command for a cable access router interface, starting from global configuration mode:

```
uBR924(config)# interface cable-modem 0
uBR924(config-if)# cable-modem upstream preamble qpsk
uBR924(config-if)#
```

Related Commands

Command	Description
cable-modem compliant bridge	Enables DOCSIS-compliant transparent bridging on the Cisco uBR900 series at startup.
cable-modem downstream saved channel	Modifies the saved downstream channel setting and upstream power value on the cable interface of a Cisco uBR900 series.
cable-modem fast-search	Enables a faster downstream search algorithm on the cable interface of a Cisco uBR900 series.
cable-modem voip best-effort	Allows voice traffic to be transmitted on the upstream via best effort rather than by assigning it a higher priority class of service.

cable-modem voip best-effort

To allow voice calls to be sent upstream over the cable interface via best effort, use the **cable-modem voip best-effort** command from interface configuration mode. To disable best-effort voice calls, use the **no** form of this command.

cable-modem voip best-effort

no cable-modem voip best-effort

Syntax Description

This command has no arguments or keywords.

Defaults

Enabled

Command Modes

Interface configuration

Command History

Release	Modification
12.0(5)T	This command was introduced.

Usage Guidelines

This command allows you to configure the voice traffic on a Cisco uBR900 series to allow only calls having a high priority service identifier (SID) to be connected.

If the dynamic configuration of high priority queues for voice traffic fails, or if the far end cannot support the multiple SIDs and multiple classes of service required by high priority traffic, the flag set by this command will be checked. If enabled (the default setting), the call will be allowed to go through. If disabled, the call will fail.

Examples

The following example shows how to disable best-effort voice calls on a Cisco uBR900 series cable interface, starting from global configuration mode:

```
uBR924(config)# interface cable-modem 0
uBR924(config-if)# no cable-modem voip best-effort
uBR924(config-if)#
```

Related Commands

Command	Description
cable-modem compliant bridge	Enables DOCSIS-compliant transparent bridging on the Cisco uBR900 series at startup.
cable-modem downstream saved channel	Modifies the saved downstream channel setting and upstream power value on the cable interface of a Cisco uBR900 series.
cable-modem fast-search	Enables a faster downstream search algorithm on the cable interface of a Cisco uBR900 series.
cable-modem upstream preamble qpsk	Enables the QPSK modulation scheme in the upstream direction from the Cisco uBR900 series to the CMTS.

interface cable-modem

To specify the cable interface on a Cisco uBR900 series cable access router, enter the **interface cable-modem** command from global configuration mode.

interface cable-modem *number*

Syntax Description

number	The interface number of the cable interface on the rear panel of the cable access router.

Defaults

Disabled

Command Modes

Global configuration

Command History

Release	Modification
11.3 NA	This command was introduced.

Usage Guidelines

When this command is entered, the Cisco uBR900 series cable access router switches from global configuration mode to interface configuration mode.

Examples

The following example brings up cable access router interface 0 and displays the available cable-modem interface configuration commands:

```
uBR924(config)# interface cable-modem 0
uBR924(config-if)# cable-modem ?
  compliant    Enter compliant modes for interface
  downstream   Downstream channel characteristics
  fast-search  Enable/disable the DS fast search
  upstream     upstream channel characteristics
  voip         Options for Voice over IP traffic over the cable interface

uBR924(config-if)#
```

Related Commands

Command	Description
cable-modem compliant bridge	Enables DOCSIS-compliant transparent bridging on the Cisco uBR900 series at startup.
cable-modem downstream saved channel	Modifies the saved downstream channel setting and upstream power value on the cable interface of a Cisco uBR900 series.
cable-modem fast-search	Enables a faster downstream search algorithm on the cable interface of a Cisco uBR900 series.
cable-modem upstream preamble qpsk	Enables the QPSK modulation scheme in the upstream direction from the Cisco uBR900 series to the CMTS.
cable-modem voip best-effort	Allows voice traffic to be transmitted on the upstream via best effort rather than by assigning it a higher priority class of service.

show bridge cable-modem

To display bridging information for a Cisco uBR900 series cable access router, enter the **show bridge cable-modem** command from privileged EXEC mode.

show bridge cable-modem *number*

Syntax Description

number	The interface number of the cable interface on the rear panel of the Cisco uBR900 series.

Defaults

No default behavior or values.

Command Modes

Privileged EXEC

Command History

Release	Modification
11.3 NA	This command was introduced.

Examples

Following is a sample output for this command:

```
uBR924# show bridge cable-modem 0

Total of 300 station blocks, 298 free
Codes: P - permanent, S - self

Bridge Group 59:
```

Table 5 describes the significant fields shown in the display.

Table 5 show bridge cable-modem Field Descriptions

Field	Description
Total of 300 station blocks	Total number of forwarding database elements in the system. The memory to hold bridge entries is allocated in blocks of memory sufficient to hold 300 individual entries. When the number of free entries falls below 25, another block of memory sufficient to hold another 300 entries is allocated. Thus, the total number of forwarding elements in the system is expanded dynamically, as needed, limited by the amount of free memory in the router.
Bridge Group	The number of the bridge group to which this interface is assigned.

Related Commands

Command	Description
show controllers cable-modem	Displays the current DHCP settings on point-to-point interfaces.
show interfaces cable-modem	Displays information about the cable interface on the Cisco uBR900 series cable access router.

show controllers cable-modem

To display high-level controller information about a Cisco uBR900 series cable access router, use the **show controllers cable-modem** command in privileged EXEC mode.

show controllers cable-modem *number*

Syntax Description

number	Controller number inside the Cisco uBR900 series.

Defaults

No default behavior or values.

Command Modes

Privileged EXEC

Command History

Release	Modification
11.3 NA	This command was introduced.

Usage Guidelines

The **show controllers cable-modem** display begins with information from the first few registers of the Broadcom BCM3300 chip. Next is buffer information for the receive, receive MAC message, buffer descriptor, and packet descriptor rings. Then comes MIB statistics from the BCM3300 chip, DMA base registers to indicate where the rings start, global control and status information, and finally interrupts for the interrupt code.

When using this command, be sure to check the tx_count and the tx_head and tx_tail values for the buffer descriptor (TX BD) and packet descriptor (TX PD) rings. The tx_count should be greater than 0, and the tx_head and tx_tail values should not be equal. If these values do not change for a long period of time, it indicates there are packets stuck on the ring. This condition is often caused by the headend not giving grants.

Examples

Following is sample output for the **show controllers cable-modem 0** command:

```
uBR924# show controllers cable-modem 0
BCM Cable interface 0:
BCM3300 unit 0, idb 0x200EB4, ds 0x82D4748, regaddr = 0x800000, reset_mask 0x80
station address 0010.7b43.aa01  default station address 0010.7b43.aa01
PLD VERSION: 32

MAC State is ranging_2_state, Prev States = 7
MAC mcfilter 01E02F00  data mcfilter 01000000

DS: BCM 3116 Receiver: Chip id = 2
US: BCM 3037 Transmitter: Chip id = 30B4

Tuner: status=0x00
Rx: tuner_freq 699000000, symbol_rate 5055849, local_freq 11520000
    snr_estimate 33406, ber_estimate 0, lock_threshold 26000
    QAM in lock, FEC in lock, qam_mode QAM_64
Tx: tx_freq 20000000, power_level 0x3E, symbol_rate 1280000

DHCP: TFTP server = 4.0.0.32, TOD server = 4.0.0.188
      Security server = 0.0.0.0, Timezone Offest = 0.0.4.32
      Config filename =

buffer size 1600

RX data PDU ring with 32 entries at 0x201D40
  rx_head = 0x201D78 (7), rx_p = 0x831BE04 (7)
    00 pak=0x8326318 buf=0x225626 status=0x80 pak_size=0
    01 pak=0x83241A0 buf=0x21DE5A status=0x80 pak_size=0
    02 pak=0x83239C0 buf=0x21C22A status=0x80 pak_size=0
    03 pak=0x8328C70 buf=0x22EA22 status=0x80 pak_size=0
    04 pak=0x8325F28 buf=0x22480E status=0x80 pak_size=0
    05 pak=0x8327CB0 buf=0x22B1C2 status=0x80 pak_size=0
    06 pak=0x8323BB8 buf=0x21C936 status=0x80 pak_size=0

RX MAC message ring with 8 entries at 0x201E80
  rx_head_mac = 0x201E88 (1), rx_p_mac = 0x831BE80 (1)
    00 pak=0x8326120 buf=0x224F1A status=0x80 pak_size=0
    01 pak=0x8324590 buf=0x21EC72 status=0x80 pak_size=0
    02 pak=0x8323FA8 buf=0x21D74E status=0x80 pak_size=0
    03 pak=0x8326EE8 buf=0x22806E status=0x80 pak_size=0
    04 pak=0x8328E68 buf=0x22F12E status=0x80 pak_size=0
    05 pak=0x8327AB8 buf=0x22AAB6 status=0x80 pak_size=0
    06 pak=0x8328880 buf=0x22DC0A status=0x80 pak_size=0
    07 pak=0x8326CF0 buf=0x227962 status=0xA0 pak_size=0

TX BD ring with 8 entries at 0x201FB8, tx_count = 0
  tx_head = 0x201FD8 (4), head_txp = 0x831BF20 (4)
  tx_tail = 0x201FD8 (4), tail_txp = 0x831BF20 (4)
    00 pak=0x000000 buf=0x200000 status=0x00 pak_size=0
    01 pak=0x000000 buf=0x200000 status=0x00 pak_size=0
    02 pak=0x000000 buf=0x200000 status=0x00 pak_size=0
    03 pak=0x000000 buf=0x200000 status=0x00 pak_size=0
    04 pak=0x000000 buf=0x200000 status=0x00 pak_size=0
    05 pak=0x000000 buf=0x200000 status=0x00 pak_size=0
    06 pak=0x000000 buf=0x200000 status=0x00 pak_size=0
    07 pak=0x000000 buf=0x200000 status=0x20 pak_size=0

TX PD ring with 8 entries at 0x202038, tx_count = 0
  tx_head_pd = 0x202838 (4)
  tx_tail_pd = 0x202838 (4)
    00 status=0x00 bd_index=0x0000 len=0x0000 hdr_len=0x0000
```

```
    ehdr: 01 06 02 74 34 11
    01 status=0x00 bd_index=0x0001 len=0x0000 hdr_len=0x0000
    ehdr: 01 06 02 74 34 11
    02 status=0x00 bd_index=0x0002 len=0x0000 hdr_len=0x0000
    ehdr: 01 06 02 74 34 11
    03 status=0x00 bd_index=0x0003 len=0x0000 hdr_len=0x0000
    ehdr: 01 06 02 74 34 11
    04 status=0x00 bd_index=0x0004 len=0x0000 hdr_len=0x0000
    ehdr: 01 06 02 74 34 11
    05 status=0x00 bd_index=0x0005 len=0x0000 hdr_len=0x0000
    ehdr: 01 06 02 74 34 11
    06 status=0x00 bd_index=0x0006 len=0x0000 hdr_len=0x0000
    ehdr: 01 06 02 74 34 11
    07 status=0x20 bd_index=0x0007 len=0x0000 hdr_len=0x0000
    ehdr: 01 06 02 74 34 11

MIB Statistics
  DS fifo full = 0, Rerequests = 0
  DS mac msg overruns = 0, DS data overruns = 0
  Qualified maps = 348, Qualified syncs = 73
  CRC fails = 0, HDR chk fails = 0
  Data pdus = 0, Mac msgs = 423
  Valid hdrs = 423

BCM3300 Registers:
downstream dma:
  ds_data_bd_base=0x001D40, ds_mac_bd_base=0x001E80
  ds_data_dma_ctrl=0x98, ds_mac_dma_ctrl=0xD8
  ds_dma_data_index=0x0007, ds_dma_msg_index=0x0000
upstream dma:
  us_bd_base=0x001FB8, us_pd_base=0x002038
  us_dma_ctrl=0x80, us_dma_tx_start=0x00
Global control and status:
  global_ctrl_status=0x00
interrupts:
  irq_pend=0x0008, irq_mask=0x00F7
```

Table 6 briefly describes some of the fields shown in the display. For more information, see the Broadcom documentation for the BCM3300 chip.

Table 6 show controllers cable-modem Field Descriptions

Field	Description
BCM3300 unit	The unit number of this BCM3300 chip.
idb	Interface description block number.
ds	Downstream channel.
regaddr	Indicates the start of the BCM3300 registers.
reset_mask	Indicates the bit to hit when resetting the chip.
station address	MAC address of this Cisco uBR900 series cable access router interface.
default station address	Default MAC address assigned by the factory for this Cisco uBR900 series cable access router.
PLD VERSION	PLD version of the BCM3300 chip.
MAC state	Current MAC state of the Cisco uBR900 series.
Prev States	Number of states that have previously existed since initialization.
MAC mcfilter	MAC control filter for MAC messages.

Table 6 show controllers cable-modem Field Descriptions (continued)

Field	Description
data mcfilter	MAC control filter for data.
DS	Downstream Broadcom receiver chip number and ID.
US	Upstream Broadcom transmitter chip number and ID.
Tuner: status	Current status of the tuner.
Rx: tuner_freq	Downstream frequency (in Hz) that the Cisco uBR900 series searched for and found.
symbol_rate	Downstream frequency in symbols per second.
local_freq	Frequency on which the transmitter and the tuner communicate.
snr_estimate	Estimate of signal-to-noise ratio (SNR) in Db X 1000.
ber_estimate	Estimate of bit error rate (always 0).
lock_threshold	Minimum signal-to-noise ratio (SNR) that the Cisco uBR900 series will accept as a valid lock.
qam_mode	The modulation scheme used in the downstream direction.
Tx: tx_freq	Upstream frequency sent to the Cisco uBR900 series by the CMTS in the UCD message.
power_level	Transmit power level as set in the hardware, expressed as a hexadecimal value. The units are unique to the hardware used. Use the **show controllers cable-modem 0 mac state** command to see the power level in dBmV.
symbol_rate	Upstream frequency in symbols per second.
TFTP server	IP address of the TFTP server at the headend.
TOD server	IP address of the time-of-day server at the headend.
Security server	IP address of the security server at the headend.
Timezone Offset	Correction received from the DHCP server to synchronize the Cisco uBR900 series time clock with the CMTS.
Config filename	Name of the file stored on the cable company's TFTP server that contains operational parameters for the Cisco uBR900 series.
buffer size	Size in bytes of the BCM3300 message buffers.
RX data PDU ring:	Indicates the memory location of the beginning of buffer information for the receive data ring.
rx_head	Indicates current head buffer descriptor.
rx_p	Indicates current head packet descriptor.
RX MAC message ring:	Indicates the memory location of the beginning of buffer information for the receive MAC message ring.
rx_head_mac	Indicates current head buffer descriptor.
rx_p_mac	Indicates current head packet descriptor.
TX BD ring:	Indicates the memory location of the beginning of buffer information for the transmit buffer descriptor ring.
tx_count	If tx_count is 0, or if tx_head and tx_tail are equal and there is no change for a period of time, it means there are packets stuck on the ring. This condition may be caused by the headend not giving grants.
tx_head	
head_txp	The next packet descriptor to get used, along with its index.
tx_tail	
tail_txp	The next packet descriptor to get sent, along with its index. When head_txp and tail_txp are the same, the transmit queue is empty.

Table 6 show controllers cable-modem Field Descriptions (continued)

Field	Description
TX PD ring:	Indicates the memory location of the beginning of buffer information for the transmit packet descriptor ring.
tx_head_pd	Indicates current head packet descriptor.
tx_tail_pd	Indicates current tail packet descriptor.
ehdr	Extended MCNS header.
MIB Statistics:	
DS fifo full	Number of times the downstream input first-in first-out (FIFO) buffer became full on the Cisco uBR900 series.
rerequests	Number of times a bandwidth request generated by the Cisco uBR900 series was not responded to by the CMTS.
DS mac msg overruns	Number of times the Cisco uBR900 series' DMA controller had a downstream MAC message and there were no free MAC message buffer descriptors to accept the message.
DS data overruns	Number of times the Cisco uBR900 series' DMA controller had downstream data and there were no free data PDU buffer descriptors to accept the data.
Qualified maps	Number of times a MAP message passed all filtering requirements and was received by the Cisco uBR900 series.
Qualified syncs	Number of times a timestamp message was received by the Cisco uBR900 series.
CRC fails	Number of times a MAC message failed a cyclic redundancy (CRC) check.
HDR chk fails	Number of times a MAC header failed its 16-bit CRC check. The MAC header CRC is a 16-bit Header Check Sequence (HCS) field that ensures the integrity of the MAC header even in a collision environment.
Data pdus	Total number of data PDUs (protocol data units) of all types received by the Cisco uBR900 series.
Mac msgs	Number of MAC messages received by the Cisco uBR900 series.
Valid hdrs	Number of valid headers received by the Cisco uBR900 series, including PDU headers, MAC headers, and headers only.
Global control and status:	Used to reset the BCM3300 chip.
interrupts:	Hexadecimal values of the pending IRQ interrupt and IRQ mask.

Related Commands

Command	Description
show controllers cable-modem bpkm	Displays information about the baseline privacy key management exchange between the Cisco uBR900 series and the CMTS.
show controllers cable-modem des	Displays information about the Data Encryption Standard (DES) engine registers.
show controllers cable-modem filters	Displays the registers in the MAC hardware that are used for filtering received frames.
show controllers cable-modem lookup-table	Displays the mini-slot lookup table inside a Cisco uBR900 series.
show controllers cable-modem mac	Displays detailed MAC-layer information for a Cisco uBR900 series.
show controllers cable-modem phy	Displays the contents of the registers used in the downstream physical hardware of the Cisco uBR900 sereis.
show controllers cable-modem tuner	Displays the settings for the upstream and downstream tuners used by a Cisco uBR900 series.

show controllers cable-modem bpkm

To display information about the baseline privacy key management exchange between the Cisco uBR900 series cable access router and the headend CMTS, use the **show controllers cable-modem bpkm** command in privileged EXEC mode.

show controllers cable-modem *number* **bpkm**

Syntax Description

number	Controller number inside the Cisco uBR900 series cable access router.

Defaults

No default behavior or values.

Command Modes

Privileged EXEC

Command History

Release	Modification
11.3 NA	This command was introduced.

Usage Guidelines

Baseline privacy key management exchanges take place only when both the Cisco uBR900 series and the CMTS are running code images that support baseline privacy, and the privacy class of service is enabled via the configuration file that is downloaded to the cable access router. Baseline privacy code images for the Cisco uBR900 series contain **k1** in the code image name.

Examples

The following output is displayed when the headend CMTS does not have baseline privacy enabled:

```
uBR924# show controllers cable-modem 0 bpkm
CM Baseline Privacy Key Management
  configuration (in seconds):
      authorization wait time:    10
      reauthorization wait time:  10
      authorization grace time:   600
      operational wait time:      1
      rekey wait time:            1
      tek grace time:             600
      authorization rej wait time: 60
  kek state:    STATE_B_AUTH_WAIT
  sid 4:
      tek state: No resources assigned
```

Table 7 describes the fields shown in the display.

Table 7 show controllers cable-modem bpkm Field Descriptions

Field	Description
authorization wait time	The number of seconds the Cisco uBR900 series waits for a reply after sending the Authorization Request message to the CMTS.
reauthorization wait time	The number of seconds the Cisco uBR900 series waits for a reply after it has sent an Authorization Request message to the CMTS in response to a reauthorization request or an Authorization Invalid message from the CMTS.
authorization grace time	The number of seconds before the current authorization is set to expire that the grace timer begins, signaling the Cisco uBR900 series to begin the reauthorization process.
operational wait time	The number of seconds the TEK state machine waits for a reply from the CMTS after sending its initial Key Request for its SID's keying material.
rekey wait time	The number of seconds the TEK state machine waits for a replacement key for this SID after the TEK grace timer has expired and the request for a replacement key has been made.
tek grace time	The number of seconds before the current TEK is set to expire that the TEK grace timer begins, signaling the TEK state machine to request a replacement key.
authorization rej wait time	Number of seconds the Cisco uBR900 series waits before sending another Authorization Request message to the CMTS after it has received an Authorization Reject message.
kek state	The current state of the key encryption key that the CMTS uses to encrypt the traffic encryption keys it sends to the Cisco uBR900 series.
tek state	The current state of the traffic encryption key state machine for the specified SID.

Related Commands

Command	Description
show controllers cable-modem	Displays high-level controller information about a Cisco uBR900 series cable access router.
show controllers cable-modem des	Displays information about the Data Encryption Standard (DES) engine registers.
show controllers cable-modem filters	Displays the registers in the MAC hardware that are used for filtering received frames.
show controllers cable-modem lookup-table	Displays the mini-slot lookup table inside a Cisco uBR900 series.
show controllers cable-modem mac	Displays detailed MAC-layer information for a Cisco uBR900 series.
show controllers cable-modem phy	Displays the contents of the registers used in the downstream physical hardware of the Cisco uBR900 series.
show controllers cable-modem tuner	Displays the settings for the upstream and downstream tuners used by a Cisco uBR900 series.

show controllers cable-modem des

To display information about the Data Encryption Standard (DES) engine registers, use the **show controllers cable-modem des** command in privileged EXEC mode.

show controllers cable-modem *number* **des**

Syntax Description

number	Controller number inside the Cisco uBR900 series.

Defaults

No default behavior or values.

Command Modes

Privileged EXEC

Command History

Release	Modification
11.3 NA	This command was introduced.

Examples

DES engine registers are displayed in the following example:

```
uBR924# show controllers cable-modem 0 des
downstream des:
  ds_des_key_table:
    key 0: even 0, odd 0
    key 1: even 0, odd 0
    key 2: even 0, odd 0
    key 3: even 0, odd 0
  ds_des_cbc_iv_table:
    iv  0: even 0, odd 0
    iv  1: even 0, odd 0
    iv  2: even 0, odd 0
    iv  3: even 0, odd 0
  ds_des_sid_table:
    sid_1=0x0000, sid_2=0x0000, sid_3=0x0000, sid_4=0x0000
  ds_des_sid_enable=0x80, ds_des_ctrl=0x2E
  ds_des_sv=0x0F00
  ds_unencrypted_length=0x0C
upstream des:
  us_des_key_table:
    key 0: even 0, odd 0
    key 1: even 0, odd 0
    key 2: even 0, odd 0
    key 3: even 0, odd 0
  us_des_cbc_iv_table:
    iv  0: even 0, odd 0
    iv  1: even 0, odd 0
    iv  2: even 0, odd 0
    iv  3: even 0, odd 0
```

```
pb_req_bytes_to_minislots=0x10
us_des_ctrl=0x00, us_des_sid_1= 0x1234
ds_unencrypted_length=0x0C
```

Table 8 briefly describes some of the fields shown in the display. For more information, see the Broadcom documentation for the BCM3300 chip.

Table 8 show controllers cable-modem des Field Descriptions

Field	Description
ds_des_key_table	Table showing downstream DES keys.
ds_des_cbc_iv_table	Table of downstream DES Cipher Block Chaining mode information.
ds_des_sid_table	Table showing the SID values to be enabled for DES encryption.
ds_des_sid_enable	Controls which SID entries in the SID table are enabled for encryption. In the above example, none of the entries are enabled for encryption.
ds_des_ctrl	Control register that controls the operating mode of the downstream DES engine.
ds_des_sv	DES security version register; the range of the version field in the Baseline Privacy Interface (BPI) extended headers that will be accepted by the hardware. High byte is upper limit, low byte is lower limit. The Cisco uBR900 will accept versions 0 to 15.
ds_unencrypted_length	Specifies the number of bytes that will be unencrypted at the beginning of the MAC frame. 0x0C means the first 12 bytes are not encrypted, which is what the DOCSIS Baseline Privacy specification calls for.
us_des_key_table	Table showing upstream DES keys.
us_des_cbc_iv_table	Table of upstream DES Cipher Block Chaining mode information.
us_des_ctrl	Control register that controls the operating mode of the upstream DES engine. The value 0x24 means that the upstream is configured to enable decryption and to use CBC mode.

Related Commands

Command	Description
show controllers cable-modem	Displays high-level controller information about a Cisco uBR900 series cable access router.
show controllers cable-modem bpkm	Displays information about the baseline privacy key management exchange between the Cisco uBR900 series and the CMTS.
show controllers cable-modem filters	Displays the registers in the MAC hardware that are used for filtering received frames.
show controllers cable-modem lookup-table	Displays the mini-slot lookup table inside a Cisco uBR900.
show controllers cable-modem mac	Displays detailed MAC-layer information for a Cisco uBR900.
show controllers cable-modem phy	Displays the contents of the registers used in the downstream physical hardware of the Cisco uBR900 series.
show controllers cable-modem tuner	Displays the settings for the upstream and downstream tuners used by a Cisco uBR900 series.

show controllers cable-modem filters

To display the registers in the MAC hardware that are used for filtering received frames, use the **show controllers cable-modem filters** command in privileged EXEC mode.

show controllers cable-modem *number* **filters**

Syntax Description

number	Controller number inside the Cisco uBR900 series.

Defaults

No default behavior or values.

Command Modes

Privileged EXEC

Command History

Release	Modification
11.3 NA	This command was introduced.

Usage Guidelines

Some of the filtering parameters are MAC hardware addresses, Service IDs (SIDs), and upstream channel IDs.

Examples

MAC and SID filter information is displayed in the following example:

```
uBR924# show controllers cable-modem 0 filters
downstream mac message processing:
  ds_mac_da_filters:
    filter_1=0010.7b43.aa01, filter_2=0000.0000.0000
    filter_3=0000.0000.0000, filter_4=0000.0000.0000
  ds_mac_da_filter_ctrl=0x71, ds_mac_msg_sof=0x0000
  ds_mac_da_mc=01E02F00
  map_parser_sids:
    sid_1=0x0000, sid_2=0x0000, sid_3=0x0000, sid_4=0x0000
  ds_mac_filter_ctrl=0x00, us_channel_id=0x0000
  ds_pid=0x0000, mac_msg_proto_ver=FF 00
  reg_rang_req_sid=0x0000
downstream data processing:
  ds_data_da_filter_table:
    filter_1 0010.7b43.aa01, filter_2 0000.0000.0000
    filter_3 0000.0000.0000, filter_4 0000.0000.0000
  ds_data_da_filter_ctrl=0x61, ds_pdu_sof=0xDEAD
  ds_data_da_mc=01000000
upstream processing:
  us_ctrl_status=0x04, Minislots per request=0x01
  burst_maps:
    map[0]=0 map[1]=0 map[2]=0 map[3]=0
  bytes_per_minislot_exp=0x04
  us_map_parser_minislot_adv=0x03, ticks_per_minislot=0x08, maint_xmit=0x0001
  us_sid_table:
    sid_1=0x0000, sid_2=0x0000, sid_3=0x0000, sid_4=0x0000
  max_re_req=0x0010, rang_fifo=0x00
```

Table 9 briefly describes some of the fields shown in the display. For more information, see the Broadcom documentation for the BCM3300 chip.

Table 9 show controllers cable-modem filters Field Descriptions

Field	Description
ds_mac_da_filters	Shows the MAC address of the cable interface and the MAC address of any Ethernet MAC it is bridging.
ds_mac_da_filter_ctrl	Downstream MAC filter control for data.
ds_mac_msg_sof	Downstream MAC message start of frame.
ds_mac_da_mc	Downstream MAC control filter for data.
map_parser_sids	Service IDs used for upstream bandwidth allocation.
ds_mac_filter_ctrl	Downstream MAC filter control for MAC messages.
us_channel_id	Upstream channel ID.
ds_pid	Downstream packet ID
mac_msg_proto_ver	Version of the MAC management protocol in use.
reg_rang_req_sid	Service ID (SID) field of the ranging request message.
ds_data_da_filter_table	Downstream data processing filter table.
ds_data_da_filter_ctrl	Downstream data processing filter control.
ds_pdu_sof	Downstream PDU start of frame.
ds_data_da_mc	Downstream data processing MAC control.
us_ctrl_status	Upstream control status.

Table 9 show controllers cable-modem filters Field Descriptions (continued)

Field	Description
Minislots per request	Length of each registration request in mini-slots.
burst_maps	Maps the burst profiles saved in the BCM3037 registers to interval usage codes (IUCs).
bytes_per_minislot_exp	Number of bytes per expansion mini-slot.
ticks_per_minislot	Number of time ticks (6.25-microsecond intervals) in each upstream mini-slot.
maint_xmit	Number of initial maintenance transmit opportunities.
us_sid_table	Upstream service ID table.
max_re_req	Maximum number of registration re-requests allowed.
rang_fifo	Number of ranging requests that can be held in the first-in-first-out (FIFO) buffer.

Related Commands

Command	Description
show controllers cable-modem	Displays high-level controller information about a Cisco uBR900 series cable access router.
show controllers cable-modem bpkm	Displays information about the baseline privacy key management exchange between the Cisco uBR900 series and the CMTS.
show controllers cable-modem des	Displays information about the Data Encryption Standard (DES) engine registers.
show controllers cable-modem lookup-table	Displays the mini-slot lookup table inside a Cisco uBR900.
show controllers cable-modem mac	Displays detailed MAC-layer information for a Cisco uBR900.
show controllers cable-modem phy	Displays the contents of the registers used in the downstream physical hardware of the Cisco uBR900.
show controllers cable-modem tuner	Displays the settings for the upstream and downstream tuners used by a Cisco uBR900.

show controllers cable-modem lookup-table

To display the mini-slot lookup table inside a Cisco uBR900 series, use the **show controllers cable-modem lookup-table** command in privileged EXEC mode.

show controllers cable-modem *number* **lookup-table**

Syntax Description

number	Controller number inside the Cisco uBR900 series.

Defaults

No default behavior or values.

Command Modes

Privileged EXEC

Command History

Release	Modification
11.3 NA	This command was introduced.

Usage Guidelines

This command displays the details of the lookup table. The driver uses this table to convert the size of the packets that the Cisco uBR900 series wants to transmit into a bandwidth request to the CMTS in mini-slots. The contents of this table are affected by the upstream symbol rate that is negotiated between the CMTS and the cable access router.

Use this table to look up the packet size and determine how many mini-slots will be needed.

Examples

The mini-slot lookup table is displayed in the following example:

```
uBR924# show controllers cable-modem 0 lookup-table
Max Burst Size (minislots) = 0x6
Max Burst Length (bytes) = 0x4B

PHY Overhead Lookup Table:

000:    01 06 06 06 06 06 06 06 06 06 06 06 06 06 06 06
010:    06 06 06 06 06 06 06 06 06 06 06 06 06 06 06 06
020:    06 06 06 06 06 06 06 06 06 06 06 06 06 06 06 06
030:    06 06 06 06 06 06 06 06 06 06 06 06 06 06 06 06
040:    06 06 06 06 06 06 06 06 06 06 06 06 10 10 10 10
050:    10 10 10 10 10 10 10 10 10 10 10 10 10 10 10 10
060:    10 10 10 10 10 10 10 10 10 10 10 10 10 10 10 10
070:    10 10 10 10 10 10 10 10 10 10 10 10 10 10 10 10
080:    10 10 10 10 10 10 10 10 10 10 10 10 10 10 10 10
090:    10 10 10 10 10 10 10 10 10 10 10 10 10 10 10 10
0A0:    10 10 10 10 10 10 10 10 10 10 10 10 10 10 10 10
0B0:    10 10 10 10 10 10 10 10 10 10 10 10 10 10 10 10
0C0:    10 10 10 10 10 10 10 10 10 10 10 10 10 10 10 10
0D0:    10 10 10 10 10 10 10 10 10 10 10 10 10 1F 1F 1F
0E0:    1F 1F 1F 1F 1F 1F 1F 1F 1F 1F 1F 1F 1F 1F 1F 1F
0F0:    1F 1F 1F 1F 1F 1F 1F 1F 1F 1F 1F 1F 1F 1F 1F 1F
100:    1F 1F 1F 1F 1F 1F 1F 1F 1F 1F 1F 1F 1F 1F 1F 1F
110:    1F 1F 1F 1F 1F 1F 1F 1F 1F 1F 1F 1F 1F 1F 1F 1F
120:    1F 1F 1F 1F 1F 1F 1F 1F 1F 1F 1F 1F 1F 1F 1F 1F
130:    1F 1F 1F 1F 1F 1F 1F 1F 1F 1F 1F 1F 1F 1F 1F 1F
140:    1F 1F 1F 1F 1F 1F 1F 1F 1F 1F 1F 1F 1F 1F 1F 1F
150:    1F 1F 1F 1F 1F 1F 1F 1F 1F 1F 1F 1F 1F 1F 1F 1F
160:    1F 1F 1F 1F 1F 1F 1F 1F 1F 1F 1F 1F 1F 1F 1F 1F
170:    1F 1F 1F 1F 1F 1F 1F 1F 1F 1F 1F 1F 1F 1F 1F 1F
180:    1F 1F 1F 1F 1F 1F 1F 1F 1F 1F 1F 1F 1F 1F 1F 1F
190:    1F 1F 1F 1F 1F 1F 1F 1F 1F 1F 1F 1F 1F 1F 1F 1F
1A0:    1F 1F 1F 1F 1F 1F 1F 1F 1F 1F 1F 1F 1F 1F 1F 1F
1B0:    1F 1F 1F 1F 1F 1F 1F 1F 2D 2D 2D 2D 2D 2D 2D 2D
1C0:    2D 2D 2D 2D 2D 2D 2D 2D 2D 2D 2D 2D 2D 2D 2D 2D
1D0:    2D 2D 2D 2D 2D 2D 2D 2D 2D 2D 2D 2D 2D 2D 2D 2D
1E0:    2D 2D 2D 2D 2D 2D 2D 2D 2D 2D 2D 2D 2D 2D 2D 2D
1F0:    2D 2D 2D 2D 2D 2D 2D 2D 2D 2D 2D 2D 2D 2D 2D 2D
200:    2D 2D 2D 2D 2D 2D 2D 2D 2D 2D 2D 2D 2D 2D 2D 2D
210:    2D 2D 2D 2D 2D 2D 2D 2D 2D 2D 2D 2D 2D 2D 2D 2D
220:    2D 2D 2D 2D 2D 2D 2D 2D 2D 2D 2D 2D 2D 2D 2D 2D
230:    2D 2D 2D 2D 2D 2D 2D 2D 2D 2D 2D 2D 2D 2D 2D 2D
240:    2D 2D 2D 2D 2D 2D 2D 2D 2D 2D 2D 2D 2D 2D 2D 2D
250:    2D 2D 2D 2D 2D 2D 2D 2D 2D 2D 2D 2D 2D 2D 2D 2D
260:    2D 2D 2D 2D 2D 2D 2D 2D 2D 2D 2D 2D 2D 2D 2D 2D
270:    2D 2D 2D 2D 2D 2D 2D 2D 2D 2D 2D 2D 2D 2D 2D 2D
280:    2D 2D 2D 2D 2D 2D 2D 2D 2D 2D 2D 2D 2D 2D 2D 2D
290:    2D 2D 2D 2D 2D 3C 3C 3C 3C 3C 3C 3C 3C 3C 3C 3C
2A0:    3C 3C 3C 3C 3C 3C 3C 3C 3C 3C 3C 3C 3C 3C 3C 3C
2B0:    3C 3C 3C 3C 3C 3C 3C 3C 3C 3C 3C 3C 3C 3C 3C 3C
2C0:    3C 3C 3C 3C 3C 3C 3C 3C 3C 3C 3C 3C 3C 3C 3C 3C
2D0:    3C 3C 3C 3C 3C 3C 3C 3C 3C 3C 3C 3C 3C 3C 3C 3C
2E0:    3C 3C 3C 3C 3C 3C 3C 3C 3C 3C 3C 3C 3C 3C 3C 3C
2F0:    3C 3C 3C 3C 3C 3C 3C 3C 3C 3C 3C 3C 3C 3C 3C 3C
300:    3C 3C 3C 3C 3C 3C 3C 3C 3C 3C 3C 3C 3C 3C 3C 3C
310:    3C 3C 3C 3C 3C 3C 3C 3C 3C 3C 3C 3C 3C 3C 3C 3C
320:    3C 3C 3C 3C 3C 3C 3C 3C 3C 3C 3C 3C 3C 3C 3C 3C
330:    3C 3C 3C 3C 3C 3C 3C 3C 3C 3C 3C 3C 3C 3C 3C 3C
340:    3C 3C 3C 3C 3C 3C 3C 3C 3C 3C 3C 3C 3C 3C 3C 3C
350:    3C 3C 3C 3C 3C 3C 3C 3C 3C 3C 3C 3C 3C 3C 3C 3C
360:    3C 3C 3C 3C 3C 3C 3C 3C 3C 3C 3C 3C 3C 3C 3C 3C
```

```
370:    3C 4B 4B 4B 4B 4B 4B 4B 4B 4B 4B 4B 4B 4B 4B
380:    4B 4B 4B 4B 4B 4B 4B 4B 4B 4B 4B 4B 4B 4B 4B
390:    4B 4B 4B 4B 4B 4B 4B 4B 4B 4B 4B 4B 4B 4B 4B
3A0:    4B 4B 4B 4B 4B 4B 4B 4B 4B 4B 4B 4B 4B 4B 4B
3B0:    4B 4B 4B 4B 4B 4B 4B 4B 4B 4B 4B 4B 4B 4B 4B
3C0:    4B 4B 4B 4B 4B 4B 4B 4B 4B 4B 4B 4B 4B 4B 4B
3D0:    4B 4B 4B 4B 4B 4B 4B 4B 4B 4B 4B 4B 4B 4B 4B
3E0:    4B 4B 4B 4B 4B 4B 4B 4B 4B 4B 4B 4B 4B 4B 4B
3F0:    4B 4B 4B 4B 4B 4B 4B 4B 4B 4B 4B 4B 4B 4B 4B
400:    4B 4B 4B 4B 4B 4B 4B 4B 4B 4B 4B 4B 4B 4B 4B
410:    4B 4B 4B 4B 4B 4B 4B 4B 4B 4B 4B 4B 4B 4B 4B
420:    4B 4B 4B 4B 4B 4B 4B 4B 4B 4B 4B 4B 4B 4B 4B
430:    4B 4B 4B 4B 4B 4B 4B 4B 4B 4B 4B 4B 4B 4B 4B
440:    4B 4B 4B 4B 4B 4B 4B 4B 4B 4B 4B 4B 5A 5A 5A
450:    5A 5A 5A 5A 5A 5A 5A 5A 5A 5A 5A 5A 5A 5A 5A
460:    5A 5A 5A 5A 5A 5A 5A 5A 5A 5A 5A 5A 5A 5A 5A
470:    5A 5A 5A 5A 5A 5A 5A 5A 5A 5A 5A 5A 5A 5A 5A
480:    5A 5A 5A 5A 5A 5A 5A 5A 5A 5A 5A 5A 5A 5A 5A
490:    5A 5A 5A 5A 5A 5A 5A 5A 5A 5A 5A 5A 5A 5A 5A
4A0:    5A 5A 5A 5A 5A 5A 5A 5A 5A 5A 5A 5A 5A 5A 5A
4B0:    5A 5A 5A 5A 5A 5A 5A 5A 5A 5A 5A 5A 5A 5A 5A
4C0:    5A 5A 5A 5A 5A 5A 5A 5A 5A 5A 5A 5A 5A 5A 5A
4D0:    5A 5A 5A 5A 5A 5A 5A 5A 5A 5A 5A 5A 5A 5A 5A
4E0:    5A 5A 5A 5A 5A 5A 5A 5A 5A 5A 5A 5A 5A 5A 5A
4F0:    5A 5A 5A 5A 5A 5A 5A 5A 5A 5A 5A 5A 5A 5A 5A
500:    5A 5A 5A 5A 5A 5A 5A 5A 5A 5A 5A 5A 5A 5A 5A
510:    5A 5A 5A 5A 5A 5A 5A 5A 5A 5A 5A 5A 5A 5A 5A
520:    5A 5A 5A 5A 5A 5A 5A 5A 68 68 68 68 68 68 68
530:    68 68 68 68 68 68 68 68 68 68 68 68 68 68 68
540:    68 68 68 68 68 68 68 68 68 68 68 68 68 68 68
550:    68 68 68 68 68 68 68 68 68 68 68 68 68 68 68
560:    68 68 68 68 68 68 68 68 68 68 68 68 68 68 68
570:    68 68 68 68 68 68 68 68 68 68 68 68 68 68 68
580:    68 68 68 68 68 68 68 68 68 68 68 68 68 68 68
590:    68 68 68 68 68 68 68 68 68 68 68 68 68 68 68
5A0:    68 68 68 68 68 68 68 68 68 68 68 68 68 68 68
5B0:    68 68 68 68 68 68 68 68 68 68 68 68 68 68 68
5C0:    68 68 68 68 68 68 68 68 68 68 68 68 68 68 68
5D0:    68 68 68 68 68 68 68 68 68 68 68 68 68 68 68
5E0:    68 68 68 68 68 68 68 68 68 68 68 68 68 68 68
5F0:    68 68 68 68 68 68 68 68 68 68 68 68 68 68 68
600:    68 68 68 68 68 77 77 77 77 77 77 77 77 77 77
610:    77 77 77 77 77 77 77 77 77 77 77 77 77 77 77
620:    77 77 77 77 77 77 77 77 77 77 77 77 77 77 77
630:    77 77 77 77 77 77 77 77 77 77 77 77 77 77 77

PHY Reverse Lookup Table:

00:    0000 0000 0000 0000 0000 0000 004B 0000
08:    0000 0000 0000 0000 0000 0000 0000 0000
10:    00DC 00DC 00DC 00DC 00DC 00DC 00DC 00DC
18:    00DC 00DC 00DC 00DC 00DC 00DC 00DC 01B8
20:    01B8 01B8 01B8 01B8 01B8 01B8 01B8 01B8
28:    01B8 01B8 01B8 01B8 01B8 0294 0294 0294
30:    0294 0294 0294 0294 0294 0294 0294 0294
38:    0294 0294 0294 0294 0370 0370 0370 0370
40:    0370 0370 0370 0370 0370 0370 0370 0370
48:    0370 0370 0370 044C 044C 044C 044C 044C
50:    044C 044C 044C 044C 044C 044C 044C 044C
58:    044C 044C 0528 0528 0528 0528 0528 0528
60:    0528 0528 0528 0528 0528 0528 0528 0528
68:    0604 0604 0604 0604 0604 0604 0604 0604
70:    0604 0604 0604 0604 0604 0604 0604 06E0
78:    06E0 06E0 06E0 06E0 06E0 06E0 06E0 06E0
80:    06E0 06E0 06E0 06E0 06E0 06E0 07BC 07BC
```

```
88:    07BC 07BC 07BC 07BC 07BC 07BC 07BC 07BC
90:    07BC 07BC 07BC 07BC 07BC 0898 0898 0898
98:    0898 0898 0898 0898 0898 0898 0898 0898
A0:    0898 0898 0898 0974 0974 0974 0974 0974
A8:    0974 0974 0974 0974 0974 0974 0974 0974
B0:    0974 0974 0A50 0A50 0A50 0A50 0A50 0A50
B8:    0A50 0A50 0A50 0A50 0A50 0A50 0A50 0A50
C0:    0A50 0B2C 0B2C 0B2C 0B2C 0B2C 0B2C 0B2C
C8:    0B2C 0B2C 0B2C 0B2C 0B2C 0B2C 0B2C 0B2C
D0:    0C08 0C08 0C08 0C08 0C08 0C08 0C08 0C08
D8:    0C08 0C08 0C08 0C08 0C08 0C08 0CE4 0CE4
E0:    0CE4 0CE4 0CE4 0CE4 0CE4 0CE4 0CE4 0CE4
E8:    0CE4 0CE4 0CE4 0CE4 0CE4 0DC0 0DC0 0DC0
F0:    0DC0 0DC0 0DC0 0DC0 0DC0 0DC0 0DC0 0DC0
F8:    0DC0 0DC0 0DC0 0DC0 0E9C 0E9C 0E9C 0E9C
```

Related Commands

Command	Description
show controllers cable-modem	Displays high-level controller information about a Cisco BR900 series cable access router.
show controllers cable-modem bpkm	Displays information about the baseline privacy key management exchange between the Cisco uBR900 series and the CMTS.
show controllers cable-modem des	Displays information about the Data Encryption Standard (DES) engine registers.
show controllers cable-modem filters	.Displays the registers in the MAC hardware that are used for filtering received frames.
show controllers cable-modem mac	Displays detailed MAC-layer information for a Cisco uBR900.
show controllers cable-modem phy	Displays the contents of the registers used in the downstream physical hardware of the Cisco uBR900.
show controllers cable-modem tuner	Displays the settings for the upstream and downstream tuners used by a Cisco uBR900.

show controllers cable-modem mac

To display detailed MAC-layer information for a Cisco uBR900 series, use the **show controllers cable-modem mac** command in privileged EXEC mode.

show controllers cable-modem *number* **mac** [**errors** | **hardware** | **log** | **resets** | **state**]

Syntax Description

number	Controller number inside the Cisco uBR900 series.
errors	(Optional) Displays a log of the error events that are reported to SNMP. This keyword enables you to look at the error events without accessing a MIB.
hardware	(Optional) Displays all MAC hardware registers.
log	(Optional) Displays a history of MAC log messages, up to 1023 entries. This is the same output that is displayed when using the **debug cable-modem mac log** command.
resets	(Optional) Extracts all of the reset causes out of the MAC log file and summarizes them in a mini report.
state	(Optional) Displays a summary of the MAC state.

Defaults

No default behavior or values.

Command Modes

Privileged EXEC

Command History

Release	Modification
11.3 NA	This command was introduced.

Usage Guidelines

MAC log messages are written to a circular log file even when debugging is not turned on. These messages include timestamps, events, and information pertinent to these events. Use the **show controllers cable-modem mac log** command to view MAC log messages.

If the Cisco uBR900 series interface fails to come up or resets periodically, the MAC log will capture what happened. For example, if an address is not obtained from the DHCP server, an error is logged, initialization starts over, and the Cisco uBR900 series scans for a downstream frequency.

The most useful keywords for troubleshooting a Cisco uBR900 series are **log**, **errors**, and **resets**. See Example 1, Example 2, and Example 3.

Example 1

The following sample display shows the MAC log file for a cable-modem interface that has successfully registered with the CMTS:

```
uBR924# show controllers cable-modem 0 mac log
00:14:24:    864.124 CMAC_LOG_DRIVER_INIT_IDB_RESET             0x080B7430
00:14:24:    864.128 CMAC_LOG_LINK_DOWN
00:14:24:    864.132 CMAC_LOG_RESET_FROM_DRIVER
00:14:24:    864.134 CMAC_LOG_STATE_CHANGE                      wait_for_link_up_state
00:14:24:    864.138 CMAC_LOG_LINK_UP
00:14:24:    864.142 CMAC_LOG_STATE_CHANGE                      ds_channel_scanning_state
00:14:24:    864.270 CMAC_LOG_WILL_SEARCH_DS_FREQUENCY_BAND     81/453000000/855000000/6000000
00:14:24:    864.276 CMAC_LOG_WILL_SEARCH_DS_FREQUENCY_BAND     82/93000000/105000000/6000000
00:14:24:    864.280 CMAC_LOG_WILL_SEARCH_DS_FREQUENCY_BAND     83/111025000/117025000/6000000
00:14:24:    864.286 CMAC_LOG_WILL_SEARCH_DS_FREQUENCY_BAND     84/231012500/327012500/6000000
00:14:24:    864.290 CMAC_LOG_WILL_SEARCH_DS_FREQUENCY_BAND     85/333025000/333025000/6000000
00:14:24:    864.294 CMAC_LOG_WILL_SEARCH_DS_FREQUENCY_BAND     86/339012500/399012500/6000000
00:14:24:    864.300 CMAC_LOG_WILL_SEARCH_DS_FREQUENCY_BAND     87/405000000/447000000/6000000
00:14:24:    864.304 CMAC_LOG_WILL_SEARCH_DS_FREQUENCY_BAND     88/123012500/129012500/6000000
00:14:24:    864.310 CMAC_LOG_WILL_SEARCH_DS_FREQUENCY_BAND     89/135012500/135012500/6000000
00:14:24:    864.314 CMAC_LOG_WILL_SEARCH_DS_FREQUENCY_BAND     90/141000000/171000000/6000000
00:14:24:    864.320 CMAC_LOG_WILL_SEARCH_DS_FREQUENCY_BAND     91/219000000/225000000/6000000
00:14:24:    864.324 CMAC_LOG_WILL_SEARCH_DS_FREQUENCY_BAND     92/177000000/213000000/6000000
00:14:24:    864.330 CMAC_LOG_WILL_SEARCH_DS_FREQUENCY_BAND     93/55752700/67753300/6000300
00:14:24:    864.334 CMAC_LOG_WILL_SEARCH_DS_FREQUENCY_BAND     94/79753900/85754200/6000300
00:14:24:    864.340 CMAC_LOG_WILL_SEARCH_DS_FREQUENCY_BAND     95/175758700/211760500/6000300
00:14:24:    864.344 CMAC_LOG_WILL_SEARCH_DS_FREQUENCY_BAND     96/121756000/169758400/6000300
00:14:24:    864.348 CMAC_LOG_WILL_SEARCH_DS_FREQUENCY_BAND     97/217760800/397769800/6000300
00:14:24:    864.354 CMAC_LOG_WILL_SEARCH_DS_FREQUENCY_BAND     98/73753600/115755700/6000300
00:14:24:    864.358 CMAC_LOG_WILL_SEARCH_DS_FREQUENCY_BAND     99/403770100/997799800/6000300
00:14:24:    864.364 CMAC_LOG_WILL_SEARCH_SAVED_DS_FREQUENCY    213000000
00:14:25:    865.450 CMAC_LOG_UCD_MSG_RCVD                      1
00:14:25: %LINK-3-UPDOWN: Interface cable-modem0, changed state to up
00:14:26:    866.200 CMAC_LOG_DS_64QAM_LOCK_ACQUIRED            213000000
00:14:26:    866.204 CMAC_LOG_DS_CHANNEL_SCAN_COMPLETED
00:14:26:    866.206 CMAC_LOG_STATE_CHANGE                      wait_ucd_state
00:14:26: %LINEPROTO-5-UPDOWN: Line protocol on Interface cable-modem0, changed state to down
00:14:27:    867.456 CMAC_LOG_UCD_MSG_RCVD                      1
00:14:29:    869.470 CMAC_LOG_UCD_MSG_RCVD                      1
00:14:29:    869.472 CMAC_LOG_ALL_UCDS_FOUND
00:14:29:    869.476 CMAC_LOG_STATE_CHANGE                      wait_map_state
00:14:29:    869.480 CMAC_LOG_UCD_NEW_US_FREQUENCY              20000000
00:14:29:    869.484 CMAC_LOG_SLOT_SIZE_CHANGED                 8
00:14:29:    869.564 CMAC_LOG_FOUND_US_CHANNEL                  1
00:14:31:    871.484 CMAC_LOG_UCD_MSG_RCVD                      1
00:14:31:    871.692 CMAC_LOG_MAP_MSG_RCVD
00:14:31:    871.694 CMAC_LOG_INITIAL_RANGING_MINISLOTS         40
00:14:31:    871.696 CMAC_LOG_STATE_CHANGE                      ranging_1_state
00:14:31:    871.700 CMAC_LOG_RANGING_OFFSET_SET_TO             9610
00:14:31:    871.704 CMAC_LOG_POWER_LEVEL_IS                    32.0  dBmV (commanded)
00:14:31:    871.708 CMAC_LOG_STARTING_RANGING
00:14:31:    871.710 CMAC_LOG_RANGING_BACKOFF_SET               0
00:14:31:    871.714 CMAC_LOG_RNG_REQ_QUEUED                    0
00:14:32:    872.208 CMAC_LOG_RNG_REQ_TRANSMITTED
00:14:32:    872.216 CMAC_LOG_RNG_RSP_MSG_RCVD
00:14:32:    872.218 CMAC_LOG_RNG_RSP_SID_ASSIGNED              16
00:14:32:    872.222 CMAC_LOG_ADJUST_RANGING_OFFSET             2853
00:14:32:    872.224 CMAC_LOG_RANGING_OFFSET_SET_TO             12463
00:14:32:    872.228 CMAC_LOG_ADJUST_TX_POWER                   8
00:14:32:    872.230 CMAC_LOG_POWER_LEVEL_IS                    34.0  dBmV (commanded)
00:14:32:    872.234 CMAC_LOG_STATE_CHANGE                      ranging_2_state
00:14:32:    872.238 CMAC_LOG_RNG_REQ_QUEUED                    16
00:14:32:    872.848 CMAC_LOG_RNG_REQ_TRANSMITTED
00:14:32:    872.852 CMAC_LOG_RNG_RSP_MSG_RCVD
```

```
00:14:32:    872.856 CMAC_LOG_RANGING_SUCCESS
00:14:32:    872.874 CMAC_LOG_STATE_CHANGE                       dhcp_state
00:14:33:    873.386 CMAC_LOG_DHCP_ASSIGNED_IP_ADDRESS           188.188.1.62
00:14:33:    873.388 CMAC_LOG_DHCP_TFTP_SERVER_ADDRESS           4.0.0.32
00:14:33:    873.392 CMAC_LOG_DHCP_TOD_SERVER_ADDRESS            4.0.0.32
00:14:33:    873.396 CMAC_LOG_DHCP_SET_GATEWAY_ADDRESS
00:14:33:    873.398 CMAC_LOG_DHCP_TZ_OFFSET                     60
00:14:33:    873.402 CMAC_LOG_DHCP_CONFIG_FILE_NAME              platinum.cm
00:14:33:    873.406 CMAC_LOG_DHCP_ERROR_ACQUIRING_SEC_SVR_ADDR
00:14:33:    873.410 CMAC_LOG_DHCP_COMPLETE
00:14:33:    873.536 CMAC_LOG_STATE_CHANGE                       establish_tod_state
00:14:33:    873.546 CMAC_LOG_TOD_REQUEST_SENT
00:14:33:    873.572 CMAC_LOG_TOD_REPLY_RECEIVED                 3140961992
00:14:33:    873.578 CMAC_LOG_TOD_COMPLETE
00:14:33:    873.582 CMAC_LOG_STATE_CHANGE                       security_association_state
00:14:33:    873.584 CMAC_LOG_SECURITY_BYPASSED
00:14:33:    873.588 CMAC_LOG_STATE_CHANGE                       configuration_file_state
00:14:33:    873.592 CMAC_LOG_LOADING_CONFIG_FILE                platinum.cm
00:14:34: %LINEPROTO-5-UPDOWN: Line protocol on Interface cable-modem0, changed state to up
00:14:34:    874.728 CMAC_LOG_CONFIG_FILE_PROCESS_COMPLETE
00:14:34:    874.730 CMAC_LOG_STATE_CHANGE                       registration_state
00:14:34:    874.734 CMAC_LOG_REG_REQ_MSG_QUEUED
00:14:34:    874.744 CMAC_LOG_REG_REQ_TRANSMITTED
00:14:34:    874.754 CMAC_LOG_REG_RSP_MSG_RCVD
00:14:34:    874.756 CMAC_LOG_COS_ASSIGNED_SID                   1/16
00:14:34:    874.760 CMAC_LOG_RNG_REQ_QUEUED                     16
00:14:34:    874.768 CMAC_LOG_REGISTRATION_OK
00
:14:34:    874.770 CMAC_LOG_REG_RSP_ACK_MSG_QUEUED             0
00:14:34:    874.774 CMAC_LOG_STATE_CHANGE                       establish_privacy_state
00:14:34:    874.778 CMAC_LOG_PRIVACY_NOT_CONFIGURED
00:14:34:    874.780 CMAC_LOG_STATE_CHANGE                       maintenance_state
00:14:34:    874.784 CMAC_LOG_REG_RSP_ACK_MESSAGE_EVENT
00:14:34:    874.788 CMAC_LOG_REG_RSP_ACK_MSG_SENT
```

If the DHCP server cannot not be reached, the error will look like this in the MAC log:

```
00:14:32:    872.874 CMAC_LOG_STATE_CHANGE                       dhcp_state
00:14:33:    873.386 CMAC_LOG_RNG_REQ_TRANSMITTED
00:14:33:    873.388 CMAC_LOG_RNG_RSP_MSG_RCVD
00:14:33:    873.386 CMAC_LOG_RNG_REQ_TRANSMITTED
00:14:33:    873.392 CMAC_LOG_RNG_RSP_MSG_RCVD
00:14:33:    873.396 CMAC_LOG_WATCHDOG_TIMER
00:14:33:    873.398 CMAC_LOG_RESET_DHCP_WATCHDOG_EXPIRED
00:14:33:    873.402 CMAC_LOG_STATE_CHANGE                       reset_interface_state
00:14:33:    873.406 CMAC_LOG_DHCP_PROCESS_KILLED
```

The fields in this display are explained in the section “Basic Troubleshooting” on page 23.

Example 2

MAC error log information is displayed in the following example, which is also reported via SNMP:

```
uBR924# show controllers cable-modem 0 mac errors
 74373.574 R02.0  No Ranging Response received.  T3 time-out.
 74374.660 R02.0  No Ranging Response received.  T3 time-out.
 74375.508 R02.0  No Ranging Response received.  T3 time-out.
 74375.748 R02.0  No Ranging Response received.  T3 time-out.
 74375.748 R03.0  Ranging Request Retries exhausted.
 74376.112 R02.0  No Ranging Response received.  T3 time-out.
 74376.354 R02.0  No Ranging Response received.  T3 time-out.
 74376.778 R02.0  No Ranging Response received.  T3 time-out.
 74377.442 R02.0  No Ranging Response received.  T3 time-out.
```

This output indicates that the Cisco uBR900 series acquired a downstream lock, successfully read a UCD, and successfully read a MAP. However, it was unable to communicate with the CMTS after ranging through all upstream transmit power levels. The Cisco uBR900 series tried to communicate with the CMTS 16 times without success, after which it reset the cable interface to try to find a better downstream frequency.

If the DHCP server could not be reached, the error would look like this in the MAC error display:

```
uBR924# show controllers cable-modem 0 mac errors
497989.804 D01.0  Discover sent no Offer received.  No available DHCP Server.
498024.046 D01.0  Discover sent no Offer received.  No available DHCP Server.
498058.284 D01.0  Discover sent no Offer received.  No available DHCP Server.
```

Example 3

The **show controllers cable-modem 0 mac resets** command shows only the entries in the MAC log that begin with the field CMAC_LOG_RESET. Collectively presenting these fields provides you with a summary of the most recent reasons why the cable interface was reset.

Reset messages and brief explanations are included in the following examples and in Table 10; however, the reset messages in Table 10 do not commonly occur.

In the following example, the configuration file downloaded from the TFTP server could not be read. The file might not exist, or the file might have incorrect permissions.

```
uBR924# show controllers cable-modem 0 mac resets
 62526.114 CMAC_LOG_RESET_CONFIG_FILE_READ_FAILED
 62564.368 CMAC_LOG_RESET_T4_EXPIRED
 62677.178 CMAC_LOG_RESET_CONFIG_FILE_READ_FAILED
 62717.462 CMAC_LOG_RESET_CONFIG_FILE_READ_FAILED
 62757.746 CMAC_LOG_RESET_CONFIG_FILE_READ_FAILED
 62796.000 CMAC_LOG_RESET_T4_EXPIRED
 62908.808 CMAC_LOG_RESET_CONFIG_FILE_READ_FAILED
 62949.092 CMAC_LOG_RESET_CONFIG_FILE_READ_FAILED
 62989.380 CMAC_LOG_RESET_CONFIG_FILE_READ_FAILED
 63029.662 CMAC_LOG_RESET_CONFIG_FILE_READ_FAILED
 63069.944 CMAC_LOG_RESET_CONFIG_FILE_READ_FAILED
 63110.228 CMAC_LOG_RESET_CONFIG_FILE_READ_FAILED
 63148.484 CMAC_LOG_RESET_T4_EXPIRED
 63261.296 CMAC_LOG_RESET_CONFIG_FILE_READ_FAILED
```

The following example shows that the DHCP server could not be reached, or that it took too long to respond.

```
uBR924# show controllers cable-modem 0 mac resets
497989.804 CMAC_LOG_RESET_DHCP_WATCHDOG_EXPIRED
498024.046 CMAC_LOG_RESET_DHCP_WATCHDOG_EXPIRED
498058.284 CMAC_LOG_RESET_DHCP_WATCHDOG_EXPIRED
```

The following example indicates that an event in the cable interface driver caused the interface to reset. This often occurs because a shut or clear command is currently being issued on the interface.

```
uBR924# show controllers cable-modem 0 mac resets
527986.444 CMAC_LOG_RESET_FROM_DRIVER
528302.042 CMAC_LOG_RESET_FROM_DRIVER
528346.600 CMAC_LOG_RESET_FROM_DRIVER
528444.494 CMAC_LOG_RESET_FROM_DRIVER
```

Table 10 Possible but Uncommon Cable Interface Reset Causes

Message	Description
CMAC_LOG_RESET_CONFIG_FILE_PARSE_FAILED	The format of the DOCSIS configuration file acquired from the TFTP server is not acceptable.
CMAC_LOG_RESET_LOSS_OF_SYNC	Synchronization with the CMTS has been lost (SYNC messages are not being received).
CMAC_LOG_RESET_T4_EXPIRED	Maintenance ranging opportunities for this Cisco uBR900 are not being received from the CMTS.
CMAC_LOG_RESET_DHCP_WATCHDOG_EXPIRED	The DHCP server took too long to respond.
CMAC_LOG_RESET_TOD_WATCHDOG_EXPIRED	The Time Of Day server took too long to respond.
CMAC_LOG_RESET_PRIVACY_WATCHDOG_EXPIRED	The baseline privacy exchange with the CMTS took too long.
CMAC_LOG_RESET_CHANGE_US_WATCHDOG_EXPIRED	The Cisco uBR900 series was unable to transmit a response to a UCC-REQ message.
CMAC_LOG_RESET_SECURITY_WATCHDOG_EXPIRED	The “full security” exchange with the CMTS took too long.
CMAC_LOG_RESET_CONFIG_FILE_WATCHDOG_EXPIRED	The TFTP server took too long to respond.
CMAC_LOG_RESET_ALL_FREQUENCIES_SEARCHED	All downstream frequencies to be searched have been searched. **Note** This message indicates that downstream frequencies were found, but the Cisco uBR900 series failed to acquire a downstream lock.
CMAC_LOG_RESET_T2_EXPIRED	Initial ranging opportunities are not being received.
CMAC_LOG_RESET_T3_RETRIES_EXHAUSTED	The CMTS failed too many times to respond to a RNG-REQ message. **Note** After 16 T3 timeouts, the Cisco uBR900 series will reset the cable interface.
CMAC_LOG_RESET_RANGING_ABORTED	The CMTS commanded the Cisco uBR900 series to abort the ranging process.
CMAC_LOG_RESET_NO_MEMORY	The Cisco uBR900 series has run out of memory.
CMAC_LOG_RESET_CANT_START_PROCESS	The Cisco uBR900 series was unable to start an internal process necessary to complete ranging and registration.
CMAC_LOG_RESET_CONFIG_FILE_READ_FAILED	The reading of the configuration file from the TFTP server failed. **Note** The file might not exist, or it might have incorrect permissions.
CMAC_LOG_RESET_AUTHENTICATION_FAILURE	The Cisco uBR900 series failed authentication as indicated in a REG-RSP message from the CMTS.

Table 10 Possible but Uncommon Cable Interface Reset Causes (continued)

Message	Description
CMAC_LOG_RESET_SERVICE_NOT_AVAILABLE	The CMTS has failed the Cisco uBR900 series' registration because a required or requested class of service is not available.
CMAC_LOG_RESET_T6_RETRIES_EXHAUSTED	The CMTS failed too many times to respond to a REG-REQ message.
CMAC_LOG_RESET_MAINTENANCE_WATCHDOG_DRIVER	The Cisco uBR900 series MAC layer failed to detect a change in the interface driver.
CMAC_LOG_RESET_NET_ACCESS_MISSING	The Network Access parameter is missing from the DOCSIS configuration file.
CMAC_LOG_RESET_FAILED_WRITE_ACCESS_CONTROL	The Cisco uBR900 series was unable to set the Write Access Control for an SNMP parameter as specified by the DOCSIS configuration file.
CMAC_LOG_RESET_DHCP_FAILED	The DHCP server did not respond with all the required values. The required values are: IP address, network mask, TFTP server IP address, TOD server IP address, DOCSIS configuration file name, and time zone offset.
CMAC_LOG_RESET_CANT_START_DS_TUNER_PRCESS	The Cisco uBR900 series was unable to start the internal process used to manage the downstream tuner.
CMAC_LOG_RESET_TOO_MANY_DS_LOCKS_LOST	Downstream QAM/FEC lock has been lost too many times.
CMAC_LOG_RESET_NO_SEND_TO_DS_TUNER_PROCESS	The Cisco uBR900 series MAC-layer process was unable to communicate with the downstream tuner management process.
CMAC_LOG_RESET_DS_TUNER_WATCHDOG	The downstream tuner process failed to report its continuing operation for a long period of time.
CMAC_LOG_RESET_UNABLE_TO_SET_MIB_OBJECT	The Cisco uBR900 series was unable to set an SNMP parameter as specified by the DOCSIS configuration file.
CMAC_LOG_RESET_MIB_OBJECT_PROCESS_WATCHDOG	The internal MIB object took too long to process the entries in the DOCSIS configuration file.

Example 4

The following example display for the **show controllers cable-modem 0 mac hardware** command shows the detailed configuration of the interface driver and the MAC-layer hardware. The most interesting bit is the station address (hardware address). The MIB statistics reflect the MAC hardware counters for various events, but these counters are typically reset every few seconds, so their contents are not accurate in this display.

```
uBR924# show controllers cable-modem 0 mac hardware
PLD VERSION: 32

BCM3300 unit 0, idb 0x200EB4, ds 0x82D4748, regaddr = 0x800000, reset_mask
0x80
station address 0010.7b43.aa01  default station address 0010.7b43.aa01
MAC mcfilter 01E02F00  data mcfilter 01000000

buffer size 1600
RX data PDU ring with 32 entries at 0x201D40
  rx_head = 0x201D40 (0), rx_p = 0x82D4760 (0)
    00 pak=0x82DF844 buf=0x227F1A status=0x80 pak_size=0
    01 pak=0x82E0BF4 buf=0x22C56A status=0x80 pak_size=0
    02 pak=0x82DF454 buf=0x22710A status=0x80 pak_size=0
    03 pak=0x82DF64C buf=0x227812 status=0x80 pak_size=0
    04 pak=0x82E0024 buf=0x229B3A status=0x80 pak_size=0
    05 pak=0x82DBF2C buf=0x21B332 status=0x80 pak_size=0
    06 pak=0x82DFE2C buf=0x229432 status=0x80 pak_size=0
    07 pak=0x82E0FE4 buf=0x22D37A status=0x80 pak_size=0
    08 pak=0x82DF064 buf=0x2262FA status=0x80 pak_size=0
    09 pak=0x82DEC74 buf=0x2254EA status=0x80 pak_size=0
    10 pak=0x82DEA7C buf=0x224DE2 status=0x80 pak_size=0
    11 pak=0x82DE884 buf=0x2246DA status=0x80 pak_size=0
    12 pak=0x82DE68C buf=0x223FD2 status=0x80 pak_size=0
    13 pak=0x82DE494 buf=0x2238CA status=0x80 pak_size=0
    14 pak=0x82DE29C buf=0x2231C2 status=0x80 pak_size=0
    15 pak=0x82DE0A4 buf=0x222ABA status=0x80 pak_size=0
    16 pak=0x82DDEAC buf=0x2223B2 status=0x80 pak_size=0
    17 pak=0x82DDCB4 buf=0x221CAA status=0x80 pak_size=0
    18 pak=0x82DDABC buf=0x2215A2 status=0x80 pak_size=0
    19 pak=0x82DD8C4 buf=0x220E9A status=0x80 pak_size=0
    20 pak=0x82DD6CC buf=0x220792 status=0x80 pak_size=0
    21 pak=0x82DD4D4 buf=0x22008A status=0x80 pak_size=0
    22 pak=0x82DD2DC buf=0x21F982 status=0x80 pak_size=0
    23 pak=0x82DD0E4 buf=0x21F27A status=0x80 pak_size=0
    24 pak=0x82DCEEC buf=0x21EB72 status=0x80 pak_size=0
    25 pak=0x82DCCF4 buf=0x21E46A status=0x80 pak_size=0
    26 pak=0x82DCAFC buf=0x21DD62 status=0x80 pak_size=0
    27 pak=0x82DC904 buf=0x21D65A status=0x80 pak_size=0
    28 pak=0x82DC70C buf=0x21CF52 status=0x80 pak_size=0
    29 pak=0x82DC514 buf=0x21C84A status=0x80 pak_size=0
    30 pak=0x82DC31C buf=0x21C142 status=0x80 pak_size=0
    31 pak=0x82DC124 buf=0x21BA3A status=0xA0 pak_size=0
RX MAC message ring with 8 entries at 0x201E80
  rx_head_mac = 0x201EB0 (6), rx_p_mac = 0x82D480C (6)
    00 pak=0x82E0DEC buf=0x22CC72 status=0x80 pak_size=0
    01 pak=0x82E021C buf=0x22A242 status=0x80 pak_size=0
    02 pak=0x82E060C buf=0x22B052 status=0x80 pak_size=0
    03 pak=0x82E11DC buf=0x22DA82 status=0x80 pak_size=0
    04 pak=0x82DFC34 buf=0x228D2A status=0x80 pak_size=0
    05 pak=0x82E09FC buf=0x22BE62 status=0x80 pak_size=0
    06 pak=0x82DEE6C buf=0x225BF2 status=0x80 pak_size=0
    07 pak=0x82DFA3C buf=0x228622 status=0xA0 pak_size=0
```

```
TX BD ring with 8 entries at 0x201FB8, tx_count = 0
  tx_head = 0x201FB8 (0), head_txp = 0x82D4888 (0)
  tx_tail = 0x201FB8 (0), tail_txp = 0x82D4888 (0)
    00 pak=0x000000 buf=0x200000 status=0x00 pak_size=0
    01 pak=0x000000 buf=0x200000 status=0x00 pak_size=0
    02 pak=0x000000 buf=0x200000 status=0x00 pak_size=0
    03 pak=0x000000 buf=0x200000 status=0x00 pak_size=0
    04 pak=0x000000 buf=0x200000 status=0x00 pak_size=0
    05 pak=0x000000 buf=0x200000 status=0x00 pak_size=0
    06 pak=0x000000 buf=0x200000 status=0x00 pak_size=0
    07 pak=0x000000 buf=0x200000 status=0x20 pak_size=0
TX PD ring with 8 entries at 0x202038, tx_count = 0
  tx_head_pd = 0x202038 (0)
  tx_tail_pd = 0x202038 (0)
    00 status=0x00 bd_index=0x0000 len=0x0000 hdr_len=0x0000
    ehdr:  00 00 00 2E FF FF
    01 status=0x00 bd_index=0x0001 len=0x0000 hdr_len=0x0000
    ehdr:  00 00 00 2E FF FF
    02 status=0x00 bd_index=0x0002 len=0x0000 hdr_len=0x0000
    ehdr:  00 00 00 2E FF FF
    03 status=0x00 bd_index=0x0003 len=0x0000 hdr_len=0x0000
    ehdr:  00 00 00 2E FF FF
    04 status=0x00 bd_index=0x0004 len=0x0000 hdr_len=0x0000
    ehdr:  00 00 00 2E 00 00
    05 status=0x00 bd_index=0x0005 len=0x0000 hdr_len=0x0000
    ehdr:  00 00 00 2E 00 00
    06 status=0x00 bd_index=0x0006 len=0x0000 hdr_len=0x0000
    ehdr:  00 00 00 00 00 00
    07 status=0x20 bd_index=0x0007 len=0x0000 hdr_len=0x0000
    ehdr:  00 00 00 00 00 00

MIB Statistics
  DS fifo full = 0, Rerequests = 0
  DS mac msg overruns = 0, DS data overruns = 0
  Qualified maps = 0, Qualified syncs = 0
  CRC fails = 0, HDR chk fails = 0
  Data pdus = 0, Mac msgs = 0
  Valid hdrs = 0
BCM3300 Registers:
downstream dma:
  ds_data_bd_base=0x001D40, ds_mac_bd_base=0x001E80
  ds_data_dma_ctrl=0x98, ds_mac_dma_ctrl=0x98
  ds_dma_data_index=0x0000, ds_dma_msg_index=0x0000
upstream dma:
  us_bd_base=0x001FB8, us_pd_base=0x002038
  us_dma_ctrl=0x00, us_dma_tx_start=0x00
global control and status:
  global_ctrl_status=0x00
interrupts:
  irq_pend=0x0018, irq_mask=0x00E7
timing recovery circuit:
  loop_enable=0x00, minislot_divisor=0x00
  K0_ctrl=0x06, K1_ctrl=0x07, acq_threshhold=0x01
  err_threshhold=0x04, timeout_threshold=0xFF
  nco_bias=0x4F7004F7, ranging_offset=0x00000000
  ts_err=0x00, sync_valid=0x00, delta_F=0x00
  timeout_err=0x00
spi:
  dynamic_ctrl=0x09, static_ctr=0x9F, autonomous=0x01
  irq_ack=0x00, spi_cmd=0x51, spi_addr=0x11
  spi_data= FF/00/00/00/00/00/00
```

```
burst profiles:
  profile 0:
             01 19 1D 00 00 00 00 00 00 00 00 00 00 00 00 00
             00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
             00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
             00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
  profile 1:
             01 19 1D 03 00 00 00 00 00 00 00 00 00 00 00 00
             00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
             00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
             00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
  profile 2:
             01 19 1D 04 00 00 00 00 00 00 00 00 00 00 00 00
             00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
             00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
             00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
  profile 3:
             00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
             00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
             00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
             00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
```

Most of the fields in this display are described in Table 15, show dhcp server Field Descriptions. Table 11 describes the MIB statistics shown in the display.

Table 11 show controllers cable-modem MIB Statistics Field Descriptions

Field	Description
DS fifo full	Number of times the downstream receive buffer on the Cisco uBR900 series has become full.
Rerequests	Number of registration requests sent by the Cisco uBR900 series to the CMTS.
DS mac msg overruns	Number of times the DMA controller has had a downstream MAC message and there were no free MAC message buffer descriptors to accept the message.
DS data overruns	Number of times the DMA controller has had downstream data and there were no free data PDU buffer descriptors to accept the data.
Qualified maps	Number of valid MAP messages received by the Cisco uBR900 series.
Qualified syncs	Number of times the Cisco uBR900 series has received synchronization with the downstream channel.
CRC fails	Number of cyclic redundancy checksums generated by the far-end device that did not match the checksums calculated from the message portions of the packets received.
HDR check fails	Number of cyclic redundancy checksums generated by the far-end device that did not match the checksums calculated from the MAC headers of the packets received. The MAC header CRC is a 16-bit Header Check Sequence (HCS) field that ensures the integrity of the MAC header even in a collision environment.
Data pdus	Total number of data PDUs (protocol data units) of all types received by the cable interface.
Mac msgs	Number of MAC messages received by the cable interface.
Valid hdrs	Number of valid MAC headers received by the cable interface.

Below the MIB statistics in the **show controllers cable-modem 0 mac hardware** display, the BCM3300 registers section shows the DMA locations of the indicated processing routines of the Broadcom 3220 MAC chip within the Cisco uBR900 series.

Example 5

The **show controllers cable-modem mac state** command summarizes the state of the cable MAC layer and provides a list of downstream search frequency bands and the order in which they are searched. If the cable MAC layer is in the `wait_for_link_up_state`, the information shown in the display corresponds to the last time the interface was up. This allows useful information to be acquired from this display even though the modem has not been able to range and register. The normal operational state of the interface is the `maintenance_state`.

```
uBR924# show controller cable-modem 0 mac state
MAC State:                  maintenance_state
Ranging SID:                5
Registered:                 TRUE
Privacy Established:        TRUE

MIB Values:
  Mac Resets:       0
  Sync lost:        0
  Invalid Maps:     0
  Invalid UCDs:     0
  Invalid Rng Rsp:  0
  Invalid Reg Rsp:  0
  T1 Timeouts:      0
  T2 Timeouts:      0
  T3 Timeouts:      4
  T4 Timeouts:      0
  Range Aborts:     0

DS ID:                      1
DS Frequency:               663000000
DS Symbol Rate:             5056941
DS QAM Mode                 64QAM
DS Search:
  88 453000000 855000000 6000000
  89  93000000 105000000 6000000
  90 111250000 117250000 6000000
  91 231012500 327012500 6000000
  92 333015000 333015000 6000000
  93 339012500 399012500 6000000
  94 405000000 447000000 6000000
  95 123015000 129015000 6000000
  96 135012500 135012500 6000000
  97 141000000 171000000 6000000
  98 219000000 225000000 6000000
  99 177000000 213000000 6000000
US ID:                      1
US Frequency:               20000000
US Power Level:             34.0 (dBmV)
US Symbol Rate:             1280000
Ranging Offset:             12460
Mini-Slot Size:             8
Change Count:               4
Preamble Pattern:           CC CC CC CC CC CC CC CC  CC CC CC CC CC CC 0D 0D
                               A9 17 D9 C3 52 2F B3 86  A4 5F 67 0D 48 BE CE 1A
                               91 7D 9C 35 22 FB 38 6A  45 F6 70 D4 8B EC E1 A9
                               17 D9 C3 52 2F B3 86 A4  5F 67 0D 48 BE CE 1A 91
                               F3 F3 F3 F3 F3 F3 F3 F3  F3 F3 F3 F3 F3 F3 F3 F3
                               F3 F3 F3 F3 F3 F3 F3 F3  F3 F3 F3 F3 33 F7 33 F7
                               88 84 04 4C C4 84 C0 0C  44 08 08 CC 8C 0C 80 48
                               88 40 44 CC 48 4C 00 C4  40 80 8C C8 C0 C8 04 88
```

```
Burst Descriptor  0:
  Interval Usage Code:      1
  Modulation Type:          1
  Differential Encoding:    2
  Preamble Length:          64
  Preamble Value Offset:    56
  FEC Error Correction:     0
  FEC Codeword Info Bytes:  16
  Scrambler Seed:           338
  Maximum Burst Size:       1
  Guard Time Size:          8
  Last Codeword Length:     1
  Scrambler on/off:         1
Burst Descriptor  1:
  Interval Usage Code:      3
  Modulation Type:          1
  Differential Encoding:    2
  Preamble Length:          128
  Preamble Value Offset:    0
  FEC Error Correction:     5
  FEC Codeword Info Bytes:  34
  Scrambler Seed:           338
  Maximum Burst Size:       0
  Guard Time Size:          48
  Last Codeword Length:     1
  Scrambler on/off:         1
Burst Descriptor  2:
  Interval Usage Code:      4
  Modulation Type:          1
  Differential Encoding:    2
  Preamble Length:          128
  Preamble Value Offset:    0
  FEC Error Correction:     5
  FEC Codeword Info Bytes:  34
  Scrambler Seed:           338
  Maximum Burst Size:       0
  Guard Time Size:          48
  Last Codeword Length:     1
  Scrambler on/off:         1
Burst Descriptor  3:
  Interval Usage Code:      5
  Modulation Type:          1
  Differential Encoding:    2
  Preamble Length:          72
  Preamble Value Offset:    48
  FEC Error Correction:     5
  FEC Codeword Info Bytes:  75
  Scrambler Seed:           338
  Maximum Burst Size:       0
  Guard Time Size:          8
  Last Codeword Length:     1
  Scrambler on/off:         1
Config File:
Network Access:             TRUE
  Vendor ID:                0.240.30
    Baseline Privacy:
    Auth. Wait Timeout:     10
    Reauth. Wait Timeout:   10
    Auth. Grace Time:       600
    Op. Wait Timeout:       1
    Retry Wait Timeout:     1
    TEK Grace Time:         600
    Auth. Reject Wait Time: 60
```

```
  COS  1:
    Assigned SID:           5
    Max Downstream Rate:    4000000
    Max Upstream Rate:      2000000
    Upstream Priority:      7
    Min Upstream Rate:      100000
    Max Upstream Burst:     12
    Privacy Enable:         TRUE
Ranging Backoff Start:      0 (at initial ranging)
Ranging Backoff End:        4 (at initial ranging)
Data Backoff Start:         0 (at initial ranging)
Data Backoff End:           4 (at initial ranging)
IP Address:                 0.0.0.0
Net Mask:                   0.0.0.0

TFTP Server IP Address:     223.255.254.254
Time Server IP Address:     188.188.1.5
Config File Name:           muck/ebuell/tftp/cm_conf
Time Zone Offset:           -28800
```

Table 12 describes the fields shown in the display.

Table 12 show controllers cable-modem MAC State Field Descriptions

Field	Description
MAC State	Current operational state of the MAC layer of the Cisco uBR900 series.
Ranging SID	Service ID used for ranging requests.
Registered	Indicates whether or not the Cisco uBR900 is currently registered with the CMTS.
Privacy Established	Indicates whether or not keys for baseline privacy have been exchanged between the Cisco uBR900 series and the CMTS, establishing privacy.
Mac Resets	Number of times the Cisco uBR900 series reset or initialized this interface.
Sync lost	Number of times the Cisco uBR900 series lost synchronization with the downstream channel.
Invalid Maps	Number of times the Cisco uBR900 series received invalid MAP messages.
Invalid UCDs	Number of times the Cisco uBR900 series received invalid UCD messages.
Invalid Rng Rsp	Number of times the Cisco uBR900 series received invalid ranging response messages.
Invalid Reg Rsp	Number of times the Cisco uBR900 series received invalid registration response messages.
T1 Timeouts	Number of timeouts caused by the Cisco uBR900 series not receiving a valid upstream channel descriptor (UCD) from the CMTS within the specified time.
T2 Timeouts	Number of timeouts caused by the Cisco uBR900 series not receiving a maintenance broadcast for ranging opportunities from the CMTS within a specified time.
T3 Timeouts	Number of timeouts caused by the Cisco uBR900 series not receiving a response within a specified time from the CMTS to a RNG-REQ message during initial maintenance.
T4 Timeouts	Number of timeouts caused by the Cisco uBR900 series not receiving a response within a specified time from the CMTS to a periodic maintenance request.
Range Aborts	Number of times the ranging process was aborted by the CMTS.
DS ID	Identifier of the downstream channel on which this MAC management message has been transmitted. This identifier is arbitrarily chosen by the CMTS and is only unique within the MAC-sublayer domain.

Table 12 show controllers cable-modem MAC State Field Descriptions (continued)

Field	Description
DS Frequency	Downstream frequency acquired by the Cisco uBR900 series during its last initialization sequence.
DS Symbol Rate	Downstream frequency in symbols per second.
DS QAM Mode	Downstream modulation scheme being used by the Cisco uBR900 series.
DS Search	Frequency bands scanned by the Cisco uBR900 series when searching for a downstream channel. The Cisco uBR900 series' default frequency bands correspond to the North American EIA CATV channel plan for 6 MHz channel slots between 90 MHz and 858 MHz.
US ID	Identifier of the upstream channel to which this MAC management message refers. This identifier is arbitrarily chosen by the CMTS and is only unique within the MAC-sublayer domain.
US Frequency	Transmission frequency used by the Cisco uBR900 series in the upstream direction.
US Power Level	Transmit power level of the Cisco uBR900 series in the upstream direction.
US Symbol Rate	Upstream frequency in symbols per second.
Ranging Offset	Delay correction (in increments of 6.25 s/64)applied by the Cisco uBR900 series to the CMTS upstream frame time derived at the Cisco uBR900 series. Used to synchronize the upstream transmissions in the time division multiple access (TDMA) scheme, this value is roughly equal to the round-trip delay of the Cisco uBR900 series from the CMTS.
Mini-Slot Size	Size T of the mini-slot for this upstream channel in units of the timebase tick of 6.25 s. Allowable values are 2, 4, 8, 16, 32, 64, or 128.
Change Count	Incremented by 1 by the CMTS whenever any of the values of this channel descriptor change. If the value of this count in a sebsequent upstream channel descriptor (UCD) remains the same, the Cisco uBR900 series can quickly decide that the remaining fields have not changed, and may be able to disregard the remainder of the message.
Preamble Pattern	Byte pattern used for the preamble.
Burst Descriptor:	A compound type/length/value (TLV) encoding that defines, for each type of upstream usage interval, the physical-layer characteristics that are to be used during that interval. Each burst descriptor is given an identifying number.
Interval Usage Code	Each upstream transmit burst belongs to a class which is given a number called the IUC (interval usage code). Bandwidth MAP messages are used by IUC codes to allocate upstream time slots. The following types are currently defined: 1. Request: bandwidth request slot 2. Request/Data: bandwidth request or data slot 3. Initial Maintenance: initial link registration contention slot 4. Station Maintenance: link keep-alive slot 5. Short Data Grant: short data burst slot 6. Long Data Grant: long data burst slot
Modulation Type	Upstream modulation format. (1 = QPSK; 2 = 16QAM)
Differential Encoding	Indicates whether or not differential encoding is used. (1 = yes; 2 = no)
Preamble Length	Length of the preamble in bits. This value must be an integral number of symbols—a multiple of 2 for QPSK; a multiple of 4 for 16QAM.
FEC Error Correction	Length of the forward error correction in bytes. The range is 0-10 bytes; a value of 0 implies no forward error correction.
FEC Codeword Info Bytes	Number of information bytes in the FEC codeword.

Table 12 show controllers cable-modem MAC State Field Descriptions (continued)

Field	Description
Scrambler Seed	15-bit seed value loaded at the beginning of each burst after the register has been cleared. Not used if scrambler is off.
Maximum Burst Size	Maximum number of mini-slots that can be transmitted during this burst type. When the interval type is Short Data Grant, this value must be greater than 0. If this value is 0, the burst size is limited elsewhere.
Guard Time Size	Amount of time in symbols between the center of the last symbol of a burst and the center of the first symbol of the preamble of an immediately following burst in an upstream transmission from the Cisco uBR900 series to the CMTS.
Last Codeword Length	Indicates whether or not the length of the last codeword is fixed or shortened. (1 = fixed; 2 = shortened)
Scrambler on/off	Indicates whether or not a scrambler is enabled in the upstream modulator. (1 = on; 2 = off)
Network Access	Indicates whether or not the Cisco uBR900 series has access to the HFC network.
Vendor ID	Unique identifier specifying the cable modem manufacturer.
Auth. Wait Timeout	Number of seconds the Cisco uBR900 series waits for a reply after sending the Authorization Request message to the CMTS.
Reauth. Wait Timeout	Number of seconds the Cisco uBR900 series waits for a reply after it has sent an Authorization Request message to the CMTS in response to a reauthorization request or an Authorization Invalid message from the CMTS.
Auth. Grace Time	Number of seconds before the current authorization is set to expire that the grace timer begins, signaling the Cisco uBR900 series to begin the reauthorization process.
Op. Wait Timeout	Number of seconds the TEK state machine waits for a reply from the CMTS after sending its initial Key Request for its SID's keying material.
Retry Wait Timeout	Number of seconds the TEK state machine waits for a replacement key for this SID after the TEK grace timer has expired and the request for a replacement key has been made.
TEK Grace Time	Number of seconds before the current TEK is set to expire that the TEK grace timer begins, signaling the TEK state machine to request a replacement key.
Auth. Reject Wait Time	Number of seconds the Cisco uBR900 series waits before sending another Authorization Request message to the CMTS after it has received an Authorization Reject message.
Assigned SID	Service ID assigned by the CMTS for the corresponding service class.
Max Downstream Rate	Maximum downstream rate in bits per second that the CMTS is permitted to forward to CPE unicast MAC addresses learned or configured as mapping to this Cisco uBR900. (This does not include MAC packets addressed to broadcast or multicast MAC addresses.)
Max Upstream Rate	Maximum upstream rate in bits per second that the Cisco uBR900 series is permitted to forward to the RF network. This includes packet PDU data packets addressed to broadcast or multicast addresses.
Upstream Priority	Relative priority assigned to this service class for data transmission in the upstream channel. Higher numbers indicate higher priority.
Min Upstream Rate	Date rate in bits per second that will be guaranteed to this service class on the upstream channel.
Max Upstream Burst	Maximum transmit burst in bytes allowed for this service class on the upstream channel.
Privacy Enable	Indicates whether or not Baseline Privacy is enabled for this service class.

Table 12 show controllers cable-modem MAC State Field Descriptions (continued)

Field	Description
Ranging Backoff Start	Initial back-off window for initial ranging contention, expressed as a power of 2. Valid values are from 0 to 15.
Ranging Backoff End	Final back-off window for initial ranging contention, expressed as a power of 2. Valid values are from 0 to 15.
Data Backoff Start	Initial back-off window for contention data and requests, expressed as a power of 2. Valid values are from 0 to 15.
Data Backoff End	Final back-off window for contention data and requests, expressed as a power of 2. Valid values are from 0 to 15.
IP Address	IP address of the cable interface.
Net Mask	Subnet mask of the cable interface.
TFTP Server IP Address	IP address of the CMTS TFTP server.
Time Server IP Address	IP address of the CMTS Time of Day (TOD) server.
Config File Name	Name of the configuration file that is downloaded from the TFTP server to provide the Cisco uBR900 series with operational parameters.
Time Zone Offset	Correction received from the DHCP server to synchronize the Cisco uBR900 series time clock with the CMTS.

Related Commands

Command	Description
show controllers cable-modem	Displays high-level controller information about a Cisco uBR900 series cable access router.
show controllers cable-modem bpkm	Displays information about the baseline privacy key management exchange between the Cisco uBR900 series and the CMTS.
show controllers cable-modem des	Displays information about the Data Encryption Standard (DES) engine registers.
show controllers cable-modem filters	.Displays the registers in the MAC hardware that are used for filtering received frames.
show controllers cable-modem lookup-table	Displays the mini-slot lookup table inside a Cisco uBR900 series.
show controllers cable-modem phy	Displays the contents of the registers used in the downstream physical hardware of the Cisco uBR900 series.
show controllers cable-modem tuner	Displays the settings for the upstream and downstream tuners used by a Cisco uBR900 series.

show controllers cable-modem phy

To display the contents of the registers used in the downstream physical hardware of the Cisco uBR900 series cable access router, use the **show controllers cable-modem phy** command in privileged EXEC mode.

show controllers cable-modem phy {**receive** | **transmit**}

Syntax Description

receive	Displays all receiver registers in the downstream physical hardware.
transmit	Displays all transmitter registers in the upstream physical hardware.

Defaults

No default behavior or values.

Command Modes

Privileged EXEC

Command History

Release	Modification
11.3 NA	This command was introduced.

Usage Guidelines

To understand the output from this command, consult the Broadcom specifications for the BCM3116 and BCM3037 chips.

Examples

Physical receive registers are displayed in the following example:

```
uBR924# show controllers cable-modem 0 phy receive
BCM3116 Receiver Registers: Chip ID = C2C1

  rstctl=    frzctl=20  qamctl=1B  lmsctl=0B  tpctl=00  fmtctl=24
  ffectl=3F  irqsts=09  irqmask=00 stoscm=9E  rstctr=00  frzctl2=46
  dvctl=30   idepth=55  eqlctl=00  tstctl=02  berctl=00  clkset=00
  tunset=00  tunctl=03

FFC coefficient registers:
  F0=0067FFBC  F1=FF880080  F2=00C1FEFB  F3=FF75019D
  F4=00C5FD89  F5=FF6D0485  F6=FC95F690  F7=2D280000

DFE coefficient registers:
  D00=0636031E  D01=FBDD0314  D02=0077FD39  D03=001B00C6
  D04=0024FF74  D05=0015007E  D06=000CFFC4  D07=FFC0004B
  D08=0044FFF6  D09=FFE00019  D10=00190005  D11=FFD3FFAD
  D12=FFD3FFE0  D13=001A000A  D14=FFF3FFED  D15=0008FFFD
  D16=FFFC0024  D17=0023FFDF  D18=0029FFFF  D19=000D001E
  D20=00020017  D21=00250001  D22=0007FFF4  D23=FFF60014
```

```
ldsft=B0EE      ldsnre=0098AF  ldif=0D004E   ldbbi=00000000
ldbbq=00000000  ldali=032E00   ldaii=E62AF2  ldbrfo=705A05
ldbri=F9CDC200  lddrfo=007E7D  lddri=007EF0

FEC correctable error count:   0
FEC uncorrectable error count: 0
Bit Error Rate Count: 0
```

Physical transmit registers are displayed in the following example:

```
uBR924# show controllers cable-modem 0 phy transmit
BCM3037 Transmitter Registers:
part_id     = 3037       rev_id      = 01
test_mode   = 00         test_input  = 00
test_misc   = 2009       rst         = 00
power       = 0000       power_2     = 00
port        = 6F         pll         = F7
map         = 66         mod         = 28
tx_oen_bdly = 14         tx_oen_edly = C8
prbs_cfg    = 00C000     baud        = 1A36E3
burst       = 0000       if_freq     = 200000
dac         = 37         tx_config   = 00

burst config 0 : prbs_init    = FFFFFF   rs      = 343E
                 fec          = 00       qam     = 01
                 pream_len    = 0018     offset  = 0000
burst config 1 : prbs_init    = FFFFFE   rs      = 033B
                 fec          = 1C       qam     = 65
                 pream_len    = 0000     offset  = 0000
burst config 2 : prbs_init    = FFFFFE   rs      = 033B
                 fec          = 1D       qam     = 65
                 pream_len    = 0000     offset  = 0000
burst config 3 : prbs_init    = FFFFFE   rs      = 033B
                 fec          = 1E       qam     = 65
burst config 4 : prbs_init    = FFFFFE   rs      = 033B
                 fec          = 1F       qam     = 65
                 pream_len    = 0000     offset  = 0000
burst config 5 : prbs_init    = FFFFFE   rs      = 033B
                 fec          = 0F       qam     = 66
                 pream_len    = 0000     offset  = 0000
Eq Coeff:
00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00

Preamble values:
CC CC CC CC CC 0D 0D CC CC CC CC CC CC CC CC 0D
04 25 01 01 01 01 02 01 02 03 02 00 40 04 02 00
40 05 01 00 06 01 10 07 02 01 52 08 01 01 09 01
08 0A 01 01 0B 01 02 04 25 03 01 01 01 02 01 02
03 02 00 50 04 02 00 30 05 01 00 06 01 22 07 02
01 52 08 01 00 09 01 30 0A 01 01 0B 01 02 04 25
04 01 01 01 02 01 02 03 02 00 40 04 02 00 40 05
01 00 06 01 22 07 02 01 52 08 01 00 09 01 30 0A
```

Related Commands

Command	Description
show controllers cable-modem	Displays high-level controller information about a Cisco uBR900 series cable access router.
show controllers cable-modem bpkm	Displays information about the baseline privacy key management exchange between the Cisco uBR900 series and the CMTS.
show controllers cable-modem des	Displays information about the Data Encryption Standard (DES) engine registers.
show controllers cable-modem filters	.Displays the registers in the MAC hardware that are used for filtering received frames.
show controllers cable-modem lookup-table	Displays the mini-slot lookup table inside a Cisco uBR900 series.
show controllers cable-modem mac	Displays detailed MAC-layer information for a Cisco uBR900 series.
show controllers cable-modem tuner	Displays the settings for the upstream and downstream tuners used by a Cisco uBR900 series.

show controllers cable-modem tuner

To display the settings for the upstream and downstream tuners used by a Cisco uBR900 series cable access router, use the **show controllers cable-modem tuner** command in privileged EXEC mode.

show controllers cable-modem tuner

Syntax Description

There are no key words or arguments for this command.

Defaults

No default behavior or values.

Command Modes

Privileged EXEC

Command History

Release	Modification
11.3 NA	This command was introduced.

Examples

Typical Cisco uBR900 series tuner settings are displayed in the following example. See Table 13 for output field possibilities and descriptions.

```
uBR924# show controllers cable-modem 0 tuner
Tuner: status=0x00
Rx: tuner_freq 507000000, symbol_rate 5360736, local_freq 11520000
    snr_estimate 17488, ber_estimate 0, lock_threshold 26000
    QAM not in lock, FEC not in lock, qam_mode QAM_64
Tx: tx_freq 20000000, power_level 0x3E, symbol_rate 1280000
```

Table 13 show controllers cable-modem tuner Field Descriptions

Field	Description
tuner_freq	Indicates the current downstream frequency.
symbol_rate	Indicates the downstream symbol rate in symbols per second.
local_freq	Frequency on which the transmitter and tuner communicate.
snr_estimate	Signal to noise estimate in dB X 1000.
ber_estimate	Bit error rate estimate (always 0).
lock_threshold	Minimum signal-to-noise ratio (SNR) that the Cisco uBR900 series will accept as a valid lock.
QAM status	Indicates if QAM/FEC lock has been acquired and the modulation mode in use.
tx_freq	Upstream frequency sent to the Cisco uBR900 series by the CMTS in the UCD message.
power_level	Transmit power level as set in the hardware, given as a hexadecimal value. The units are unique to the hardware used. Use the **show controllers cable-modem 0 mac state** command to see the power level in dBmV.
symbol_rate	Indicates the upstream symbol rate in symbols per second that is negotiated between the CMTS and the cable access router.

Related Commands

Command	Description
show controllers cable-modem	Displays high-level controller information about a Cisco uBR900 series cable access router.
show controllers cable-modem bpkm	Displays information about the baseline privacy key management exchange between the Cisco uBR900 series and the CMTS.
show controllers cable-modem des	Displays information about the Data Encryption Standard (DES) engine registers.
show controllers cable-modem filters	.Displays the registers in the MAC hardware that are used for filtering received frames.
show controllers cable-modem lookup-table	Displays the mini-slot lookup table inside a Cisco uBR900 series.
show controllers cable-modem mac	Displays detailed MAC-layer information for a Cisco uBR900 series.
show controllers cable-modem phy	Displays the contents of the registers used in the downstream physical hardware of the Cisco uBR900 series.

show dhcp

To display the current DHCP settings on point-to-point interfaces, enter the **show dhcp** command from privileged EXEC mode.

show dhcp {**lease** | **server**}

Syntax Description

lease	Shows DHCP addresses leased from a server.
server	Shows known DHCP servers.

Defaults

No default behavior or values.

Command Modes

Privileged EXEC

Command History

Release	Modification
11.3 NA	This command was introduced.

Usage Guidelines

You can use this command on any point-to-point type of interface that uses DHCP for temporary IP address allocation.

Examples

Following is sample output for the **show dhcp lease** command:

```
uBR924# show dhcp lease
Temp IP addr: 188.188.1.40  for peer on Interface: cable-modem0
Temp sub net mask: 0.0.0.0
   DHCP Lease server: 4.0.0.32, state: 3 Bound
   DHCP transaction id: 2431
   Lease: 3600 secs,  Renewal: 1800 secs,  Rebind: 3150 secs
Temp default-gateway addr: 188.188.1.1
   Next timer fires after: 00:58:01
   Retry count: 0   Client-ID: 0010.7b43.aa01
```

Table 14 describes the significant fields shown in the display.

Table 14 show dhcp lease Field Descriptions

Field	Description
Temp IP addr	IP address leased from the DHCP server for the cable access router interface.
Temp subnet mask	Temporary subnet mask assigned to the cable access router interface.
DHCP Lease server	IP address of the DHCP server that assigned an IP address to this client.
state	Current state of this client (the cable access router interface). Possible states are Bound, Renew, or Rebinding. For descriptions of these states, see RFC 2131.
DHCP transaction id	Unique number established by the Cisco uBR900 series before the first request message is sent to the DHCP server. The same transaction id is used as long as the lease keeps getting renewed and is valid. If a new "discover" message is sent, a new transaction id is used.
Lease	Time (in seconds) for which the leased IP address is valid; the duration of the lease.
Renewal	Time interval (in seconds) from address assignment until the client transitions to the renewing state. When the renewal (T1) time expires, the client sends a unicast dhcprequest message to the server to extends its lease. The default value of this timer is 0.5 times the duration of the lease.
Rebind	Time interval (in seconds) from address assignment until the client transitions to the rebinding state and sends a broadcast dhcprequest message to any DHCP server to extends its lease. The default value of this timer (T2) is 0.875 times the duration of the lease.
Temp default-gateway addr	IP address of the router closest to this client on the network.
Next timer fires after	Time in hours, minutes, and seconds until the next timer expires.
Retry count	Number of times the client has sent any message to the DHCP server -- most likely a request message to extend its lease. When the lease is renewed, the Retry count is reset to 0.
Client-ID	MAC address (with optional media type code) that uniquely identifies the client on the subnet for binding lookups.

Following is sample output for the **show dhcp server** command:

```
uBR924# show dhcp server
   DHCP server: ANY (255.255.255.255)
    Leases:   1
    Offers:   1      Requests: 2     Acks: 1     Naks: 0
    Declines: 0      Releases: 0     Bad:  0
    TFTP Server Name: SOHOSERVER
    TIME0: 1.2.0.250,  TIME1: 0.0.0.0
    Subnet: 255.255.255.0
```

Table 15 describes the significant fields shown in the display.

Table 15 show dhcp server Field Descriptions

Field	Description
DHCP server	MAC address used by the DHCP server.
Leases	Number of current leased IP addresses.
Offers	Number of offers for an IP address sent to a proxy-client from the server.
Requests	Number of requests for an IP address to the server.

Table 15 show dhcp server Field Descriptions (continued)

Field	Description
Acks	Number of ‘acknowledge’ messages sent by the server to the proxy-client.
Naks	Number of ‘not acknowledge’ messages sent by the server to the proxy-client.
Declines	Number of offers from the server that have been declined by the proxy-client.
Releases	Number of times IP addresses have been relinquished gracefully by the client.
Bad	Number of bad packets received due to wrong length, wrong field type, or other causes.
TFTP Server Name	Name (if any) configured for the server providing TFTP downloads to the cable modem.
TIME0	IP address of the primary Time of Day (TOD) server.
TIME1	IP address of the secondary Time of Day (TOD) server.
Subnet	Subnet containing the DHCP server.

Related Commands

Command	Description
cable-modem voip best-effort	Allows voice traffic to be transmitted on the upstream via best effort rather than by assigning it a higher priority class of service.
show bridge cable-modem	Ddisplays bridging information for a Cisco uBR900 series cable access router.
show interfaces cable-modem	Displays information about the cable interface on the Cisco uBR900 series cable access router.

show interfaces cable-modem

To display information about the Cisco uBR900 series cable access router's cable interface, enter the **show interfaces cable-modem** command from either user EXEC mode or privileged EXEC mode.

show interfaces cable-modem *number* [**accounting** | **counters** | **crb** | **irb** | **type**]

Syntax Description

number	Cable access router interface number.
accounting	(Optional) Displays the number of packets of each protocol type that has been sent through the cable access router interface.
counters	(Optional) Shows MIB counters on the cable interface.
crb	(Optional) Displays concurrent routing and bridging information for each interface that has been configured for routing or bridging. This option does not really apply to the Cisco uBR900 series; it is included because it is part of the subsystem that provides DOCSIS-compliant bridging. For more information, refer to the *Bridging and IBM Networking Command Reference*.
irb	(Optional) Displays integrated routing and bridging information for each interface that has been configured for routing or bridging. This option does not really apply to the Cisco uBR900 series; it is included because it is part of the subsystem that provides DOCSIS-compliant bridging. For more information, refer to the *Bridging and IBM Networking Command Reference*.
type	(Optional) Designed to display information about virtual LANs associated with the interface; however, this option is not supported on the Cisco uBR900 series.

Defaults

No default behavior or values.

Command Modes

User EXEC or privileged EXEC

Command History

Release	Modification
11.3 NA	This command was introduced.

Usage Guidelines

When this command is entered without a keyword, general information about the cable interface is displayed.

Examples

Traffic passing through the cable access router interface is shown in the following example:

```
uBR924# show interfaces cable-modem 0
  cable-modem0 is up, line protocol is up
  Hardware is BCM3300, address is 0050.7366.2439 (bia 0050.7366.2439)
  Internet address is 5.2.0.11/16
  MTU 1500 bytes, BW 27000 Kbit, DLY 1000 usec,
     reliability 255/255, txload 1/255, rxload 1/255
  Encapsulation DOCSIS, loopback not set
  Keepalive set (10 sec)
  ARP type:ARPA, ARP Timeout 04:00:00
  Last input 00:00:00, output 00:00:00, output hang never
  Last clearing of "show interface" counters 00:08:40
  Queueing strategy:fifo
  Output queue 40/40, 52787 drops; input queue 0/75, 0 drops
  5 minute input rate 2000 bits/sec, 2 packets/sec
  5 minute output rate 94000 bits/sec, 154 packets/sec
     1074 packets input, 418472 bytes, 0 no buffer
     Received 19 broadcasts, 0 runts, 0 giants, 0 throttles
     0 input errors, 0 CRC, 0 frame, 0 overrun, 0 ignored, 0 abort
     78771 packets output, 6326786 bytes, 0 underruns
     0 output errors, 0 collisions, 0 interface resets
     0 output buffer failures, 0 output buffers swapped out
```

Table 16 describes the significant fields shown in the display.

Table 16 show interfaces cable-modem Field Descriptions

Field	Description
cable-modem0 is up	Indicates that the interface is currently active. “Disabled” indicates the interface has received more than 5000 errors in one keepalive interval (10 seconds by default if keepalive is set); “administratively down” indicates the interface has been taken down by an administrator.
line protocol is up	Indicates that the software processes that handle the line protocol believe the interface is usable.
Hardware	Hardware type and MAC address.
Internet address	Internet address followed by the shorthand notation for the subnet mask.
MTU	Maximum Transmission Unit (equivalent of the maximum packet size) for the interface.
BW	Bandwidth of the interface in kilobits per second.
DLY	Delay of the interface in microseconds.
reliability	Reliability of the interface, expressed as a fraction of 255, calculated as an exponential average over a 5-minute period. (255/255 equals 100% reliability.)
tx load/rx load	Load on the interface caused by transmitting and receiving, expressed as a fraction of 255, calculated as an exponential average over a 5 minute period.
Encapsulation/loopback/keepalive	Encapsulation method assigned to the interface.
loopback	Indicates whether or not loopback is set.
keepalive	Indicates whether or not keepalives are set.
ARP type	Type of Address Resolution Protocol configured for the interface.
ARP Timeout	Number of hours, minutes, and seconds an ARP cache entry will stay in the cache.

Table 16 show interfaces cable-modem Field Descriptions (continued)

Field	Description
Last input/output	Number of hours, minutes, and seconds since the last packet was successfully received/transmitted by the interface.
output hang	Number of hours, minutes, and seconds since the interface was last reset because of a transmission that took too long. When the number of hours in any of the "Last.." fields exceeds 24, the number of days and hours is displayed. If the field overflows, asterisks are printed.
Last clearing of "show interface" counters	Time at which the counters that measure cumulative statistics (such as number of bytes transmitted and received) shown in this report were last reset to zero. Note that variables that might affect routing (for example, load and reliability) are not cleared when the counters are cleared. *** indicates the elapsed time is too large to be displayed. 0:00:00 indicates the counters were cleared more than 2^{31} milliseconds (and less than 2^{32} milliseconds) ago.
Queueing strategy	Type of queueing strategy in effect on the interface.
Output queue/drops	Number of packets in the output queue followed by the size of the queue and the number of packets dropped due to a full queue.
input queue/drops	Number of packets in the input queue followed by the size of the queue and the number of packets dropped due to a full queue.
5 minute input rate 5 minute output rate	Average number of bits and packets received and transmitted per second in the last 5 minutes. If the interface is not in promiscuous mode, it senses network traffic it sends and receives (rather than all network traffic). The 5-minute input and output rates should be used only as an approximation of traffic per second during a given 5-minute period. These rates are exponentially weighted averages with a time constant of 5 minutes. A period of four time constants must pass before the average will be within two percent of the instantaneous rate of a uniform stream of traffic over that period.
packets input	Total number of error-free packets received by the system.
bytes input	Total number of bytes, including data and MAC encapsulation, in the error-free packets received by the system.
no buffer	Number of received packets discarded because there was no buffer space in the main system. Compare with ignored count. Broadcast storms on Ethernet networks and bursts of noise on serial lines are often responsible for no input buffer events.
Received broadcasts	Total number of broadcast or multicast packets received by the interface.
runts	Number of packets discarded because they were smaller than the medium's minimum packet size. For example, any Ethernet packet less than 64 bytes is considered a runt.
giants	Number of packets discarded because they were larger than the medium's maximum packet size. For example, any Ethernet packet larger than 1518 bytes is considered a giant.
throttles	Number of times the receiver on the port was disabled, possibly due to buffer or processor overload.
input errors	Includes runts, giants, no buffer, CRC, frame, overrun, and ignored counts. Other input-related errors can also cause the input errors count to be increased, and some datagrams may have more than one error; therefore, this sum may not balance with the sum of enumerated input error counts.

Table 16 show interfaces cable-modem Field Descriptions (continued)

Field	Description
CRC	Number of cyclic redundancy checksums generated by the originating LAN station or far-end device that do not match the checksum calculated from the data received. On a LAN, this usually indicates noise or transmission problems on the LAN interface or the LAN bus itself. A high number of CRCs is usually the result of collisions or a station transmitting bad data.
frame	Number of packets received incorrectly, having a CRC error and a noninteger number of octets. On a LAN, this is usually the result of collisions or a malfunctioning Ethernet device.
overrun	Number of times the receiver hardware was unable to hand received data to a hardware buffer because the input rate exceeded the receiver's ability to handle the data.
ignored	Number of received packets ignored by the interface because the interface hardware ran low on internal buffers. These buffers are different from the system buffers mentioned previously in the buffer description. Broadcast storms and bursts of noise can cause the ignored count to be increased.
abort	Number of packets whose receipt was aborted.
packets output	Total number of messages transmitted by the system.
bytes	Total number of bytes, including data and MAC encapsulation, transmitted by the system.
underruns	Number of times the transmitter has been running faster than the router can handle.
output errors	Sum of all errors that prevented the final transmission of datagrams out of the interface being examined. Note that this may not balance with the sum of the enumerated output errors, as some datagrams might have more than one error, and others might have errors that do not fall into any of the specifically tabulated categories.
collisions	Number of messages retransmitted due to an Ethernet collision. This is usually the result of an overextended LAN (Ethernet or transceiver cable too long, more than two repeaters between stations, or too many cascaded multiport transceivers). A packet that collides is counted only once in output packets.
interface resets	Number of times an interface has been completely reset. This can happen if packets queued for transmission were not sent within several seconds. On a serial line, this can be caused by a malfunctioning modem that is not supplying the transmit clock signal, or by a cable problem. If the system notices that the carrier detect line of a serial interface is up, but the line protocol is down, it periodically resets the interface in an effort to restart it. Interface resets can also occur when an interface is looped back or shut down.
output buffer failures	Number of times the output buffer has failed.
output buffers swapped out	Number of times the output buffer has been swapped out.

To display the number of packets and bytes of each protocol type passing through the cable access router interface, use the **accounting** option with the **show interface cable-modem** command:

```
uBR924# show interface cable-modem 0 accounting
cable-modem0
                Protocol    Pkts In   Chars In   Pkts Out  Chars Out
                      IP        545     185502        159      90240
           Trans. Bridge       3878     964995      12597    1611142
                     ARP         73       3066         86       4128
```

Table 17 describes the fields shown in this display.

Table 17 show interfaces cable-modem Accounting Descriptions

Field	Description
Protocol	List of protocols operating on the cable-modem interface.
Pkts In	Number of packets of each protocol received on the interface.
Chars In	Number of bytes of each protocol received on the interface.
Pkts Out	Number of packets of each protocol transmitted on the interface.
Chars Out	Number of bytes of cach protocol transmitted on the interface.

MIB counters on the cable interface are displayed in the next example:

```
uBR924# show int cable-modem 0 counters
Cable specific counters:
Ranging requests sent  : 50982
Downstream FIFO full   : 0
Re-requests            : 7277
DS MAC Message Overruns: 0
DS Data Overruns       : 0
Received MAPs          : 254339485
Received Syncs         : 53059555
Message CRC failures   : 0
Header CRC failures    : 1394
Data PDUs              : 5853
DS MAC messages        : 307861745
Valid Headers          : 307869065
Sync losses            : 0
Pulse losses           : 1
BW request failures    : 6
```

Table 18 describes the counters shown in this display.

Table 18 show interfaces cable-modem Counters Descriptions

Field	Description
Ranging requests sent	Number of ranging requests sent by the Cisco uBR900 series to the CMTS.
Downstream FIFO full	Number of times the downstream input first-in first-out (FIFO) buffer became full on the Cisco uBR900 series.
Re-requests	Number of times a bandwidth request generated by the Cisco uBR900 series was not responded to by the CMTS.
DS MAC Message Overruns	Number of times the Cisco uBR900 series's DMA controller had a downstream MAC message and there were no free MAC message buffer descriptors to accept the message.

Table 18 show interfaces cable-modem Counters Descriptions (continued)

Field	Description
DS Data Overruns	Number of times the Cisco uBR900 series's DMA controller had downstream data and there were no free data PDU buffer descriptors to accept the data.
Received MAPs	Number of times a MAP message passed all filtering requirements and was received by the Cisco uBR900 series.
Received Syncs	Number of times a timestamp message was received by the Cisco uBR900 series.
Message CRC failures	Number of times a MAC message failed a cyclic redundancy (CRC) check.
Header CRC failures	Number of times a MAC header failed its 16-bit CRC check. The MAC header CRC is a 16-bit Header Check Sequence (HCS) field that ensures the integrity of the MAC header even in a collision environment.
Data PDUs	Total number of data PDUs (protocol data units) of all types received by the Cisco uBR900 series.
DS MAC messages	Number of MAC messages received by the Cisco uBR900 series.
Valid Headers	Number of valid headers received by the Cisco uBR900 series, including PDU headers, MAC headers, and headers only.
Sync losses	Number of times the Cisco uBR900 series lost timebase sync with the CMTS.
Pulse losses	Number of times the Cisco uBR900 series did not receive expected timestamp messages from the CMTS.
BW request failures	Number of times the Cisco uBR900 series sent the maximum number of re-requests for bandwidth allocation and the request was still not granted.

Information about routing and bridging protocols and filtering on the cable access router interface is displayed in the following example:

```
uBR924# show int cable-modem 0 crb

cable-modem0

 Bridged protocols on cable-modem0:
  ip

 Software MAC address filter on cable-modem0
  Hash Len    Address      Matches  Act      Type
  0x00:  0 ffff.ffff.ffff      3877 RCV Physical broadcast
  0x2A:  0 0900.2b01.0001         0 RCV DEC spanning tree
  0x7A:  0 0010.7b43.aa01       573 RCV Interface MAC address
  0xC2:  0 0180.c200.0000         0 RCV IEEE spanning tree
  0xC2:  1 0180.c200.0000         0 RCV IBM spanning tree
```

Table 19 describes the software MAC address filter information for the cable access router interface.

Table 19 show interfaces cable-modem Routing and Bridging Descriptions

Field	Description
Hash	Hash key/relative position in the keyed list for this MAC address filter.
Len	Length of this entry to the beginning element of this hash chain.
Address	Canonical (Ethernet ordered) MAC address of this filter.
Matches	Number of received packets that match this MAC address.

Table 19 show interfaces cable-modem Routing and Bridging Descriptions (continued)

Field	Description
Act	Action to be taken when this address is looked up; choices are to receive or discard the packet.
Type	MAC address type.

Related Commands

Command	Description
cable-modem compliant bridge	Enables DOCSIS-compliant transparent bridging on the Cisco uBR900 series at startup.
cable-modem downstream saved channel	Modifies the saved downstream channel setting and upstream power value on the cable interface of a Cisco uBR900 series.
cable-modem fast-search	Enables a faster downstream search algorithm on the cable interface of a Cisco uBR900 series.
show bridge cable-modem	Displays bridging information for a Cisco uBR900 series cable access router.
show interfaces cable-modem	Displays information about the cable interface on the Cisco uBR900 series cable access router.

Debug Commands

Note Troubleshooting the Cisco uBR900 series cable access router is typically accomplished using the CMTS at the cable operator's headend facility; it is rarely done by directly accessing the Cisco uBR924. For information on troubleshooting the Cisco uBR900 series using Cisco uBR7200 series universal broadband routers, see the document *Cisco uBR7246 Universal Broadband Router Features*. Also see the "Related Documents" section on page 31 for additional documents relating to troubleshooting.

The following debug commands are available to troubleshoot a Cisco uBR900 series cable access router:

- **debug cable-modem bpkm**
- **debug cable-modem bridge**
- **debug cable-modem error**
- **debug cable-modem interrupts**
- **debug cable-modem mac**
- **debug cable-modem map**

All commands relating to VoIP applications are documented in the *Debug Command Reference* for Cisco IOS Release 12.0, which can be accessed online or on the Documentation CDROM by going to **Cisco IOS Release 12.0** and selecting **Supporting Documents**.

Note Hidden debug commands for the Cisco uBR900 series cable access router are not documented.

debug cable-modem bpkm

To debug baseline privacy information on a Cisco uBR900 series, use the **debug cable-modem bpkm** command in privileged EXEC mode. To turn the debugging messages off, use the **no** form of this command.

[**no**] **debug cable-modem bpkm** {**errors** | **events** | **packets**}

Syntax Description

errors	Debugs Cisco uBR900 series privacy errors.
events	Debugs events related to cable baseline privacy.
packets	Debugs baseline privacy packets.

Defaults

No default behavior or values.

Command Modes

Privileged EXEC

Command History

Release	Modification
11.3 NA	This command was introduced.

Usage Guidelines

Baseline privacy key management exchanges take place only when both the Cisco uBR900 series and the CMTS are running code images that support baseline privacy, and the privacy class of service is enabled via the configuration file that is downloaded to the cable access router. Baseline privacy code images for the Cisco uBR900 series contain **k1** in the code image name.

Examples

The following example shows debug output when the headend does not have privacy enabled:

```
uBR924# debug cable-modem bpkm errors
cm_bpkm_fsm(): machine: KEK, event/state: EVENT_4_TIMEOUT/STATE_B_AUTH_WAIT, new state:
STATE_B_AUTH_WAIT

cm_bpkm_fsm(): machine: KEK, event/state: EVENT_4_TIMEOUT/STATE_B_AUTH_WAIT, new state:
STATE_B_AUTH_WAIT

%LINEPROTO-5-UPDOWN: Line protocol on Interface cable-modem0, changed state to down
cm_bpkm_fsm(): machine: KEK, event/state: EVENT_1_PROVISIONED/STATE_A_START, new state:
STATE_B_AUTH_WAIT

%LINEPROTO-5-UPDOWN: Line protocol on Interface cable-modem0, changed state to up
```

Related Commands

Command	Description
debug cable-modem bridge	Debugs bridge filter processing information on a Cisco uBR900 series cable access router.
debug cable-modem error	Enables debugging messages for the cable interface driver on a Cisco uBR900 series.
debug cable-modem interrupts	Debugs Cisco uBR900 series interrupts.
debug cable-modem mac	Troubleshoots the Cisco uBR900 series MAC layer.
debug cable-modem map	Displays the timing from MAP messages to sync messages and the timing between MAP messages.

debug cable-modem bridge

Use the **debug cable-modem bridge** command in privileged EXEC mode to debug bridge filter processing information on a Cisco uBR900 series. To turn the debugging messages off, use the **no** form of this command.

[**no**] **debug cable-modem bridge**

Syntax Description

This command has no keywords or arguments.

Defaults

No default behavior or values.

Command Modes

Privileged EXEC

Command History

Release	Modification
11.3 NA	This command was introduced.

Usage Guidelines

When the interface is down, all bridge table entries learned on the Ethernet interface are set to discard because traffic is not bridged until the cable interface has completed initialization. After the interface (the line protocol) is completely up, bridge table entries learned on the Ethernet interface program the cable MAC data filters. The cable MAC hardware filters out any received packets whose addresses are not in the filters. In this way, the cable interface only receives packets addressed to its own MAC address or an address it has learned on the Ethernet interface.

Examples

The following example shows sample display output for the **debug cable-modem bridge** privileged EXEC command:

```
uBR924# debug cable-modem bridge
%LINEPROTO-5-UPDOWN: Line protocol on Interface cable-modem0, changed state to downshut
cm_tbridge_add_entry(): MAC not initialized, discarding entry: 00e0.fe7a.186fno shut
cm_tbridge_add_entry(): MAC not initialized, discarding entry: 00e0.fe7a.186f
%LINEPROTO-5-UPDOWN: Line protocol on Interface cable-modem0, changed state to up
cm_tbridge_add_entry(): Adding entry 00e0.fe7a.186f to filter 2
```

Related Commands

Command	Description
debug cable-modem bpkm	Debugs baseline privacy information on a Cisco uBR900 series.
debug cable-modem error	Enables debugging messages for the cable interface driver on a Cisco uBR900 series.
debug cable-modem interrupts	Debugs Cisco uBR900 series interrupts.
debug cable-modem mac	Troubleshoots the Cisco uBR900 series MAC layer.
debug cable-modem map	Displays the timing from MAP messages to sync messages and the timing between MAP messages.

debug cable-modem error

Use the the **debug cable-modem error** command in privileged EXEC mode to enable debugging messages for the cable interface driver. To turn the debugging messages off, use the **no** form of this command.

[**no**] **debug cable-modem error**

Syntax Description

This command has no keywords or arguments.

Defaults

No default behavior or values.

Command Modes

Privileged EXEC

Command History

Release	Modification
11.3 NA	This command was introduced.

Usage Guidelines

This command displays detailed output about the sanity checking of received frame formats, the acquisition of downstream QAM/FEC lock, the receipt or non-receipt of SYNC messages from the CMTS, reception errors, and bandwidth request failures.

Examples

The following example shows sample display output for the **debug cable-modem error** privileged EXEC command:

```
uBR924# debug cable-modem error
*Mar  7 20:16:29: AcquireSync(): Update rate is 100 Hz
*Mar  7 20:16:30: 1st Sync acquired after 1100 ms.
*Mar  7 20:16:30: Recovery loop is locked (7/9)
*Mar  7 20:16:30: 2nd Sync acquired after 100 ms.
*Mar  7 20:16:30: Recovery loop is locked (10/15)
```

Related Commands

Command	Description
debug cable-modem bpkm	Debugs baseline privacy information on a Cisco uBR900 series.
debug cable-modem bridge	Debugs bridge filter processing information on a Cisco uBR900 series.
debug cable-modem interrupts	Debugs Cisco uBR900 series interrupts.
debug cable-modem mac	Troubleshoots the Cisco uBR900 series MAC layer.
debug cable-modem map	Displays the timing from MAP messages to sync messages and the timing between MAP messages.

debug cable-modem interrupts

To debug Cisco uBR900 series interrupts, use the **debug cable-modem interrupts** command in privileged EXEC mode . To turn the debugging messages off, use the **no** form of this command.

[**no**] **debug cable-modem interrupts**

Syntax Description

This command has no keywords or arguments.

Defaults

No default behavior or values.

Command Modes

Privileged EXEC

Command History

Release	Modification
11.3 NA	This command was introduced.

Examples

The following example shows sample debug output for Cisco uBR900 series interrupts.

```
uBR924# debug cable-modem interrupts
*** BCM3300_rx_mac_msg_interrupt ***
*** BCM3300_rx_mac_msg_interrupt ***
### BCM3300_tx_interrupt ###
*** BCM3300_rx_mac_msg_interrupt ***
### BCM3300_tx_interrupt ###
*** BCM3300_rx_mac_msg_interrupt ***
### BCM3300_tx_interrupt ###
### BCM3300_tx_interrupt ###
### BCM3300_tx_interrupt ###
### BCM3300_tx_interrupt ###
```

Related Commands

Command	Description
debug cable-modem bpkm	Debugs baseline privacy information on a Cisco uBR900 series.
debug cable-modem bridge	Debugs bridge filter processing information on a Cisco uBR900 series.
debug cable-modem error	Enables debugging messages for the cable interface driver on a Cisco uBR900 series.
debug cable-modem mac	Troubleshoots the Cisco uBR900 series MAC layer.
debug cable-modem map	Displays the timing from MAP messages to sync messages and the timing between MAP messages.

debug cable-modem mac

To troubleshoot the Cisco uBR900 series MAC layer, use the **debug cable-modem mac** command in privileged EXEC mode. To turn the debugging messages off, use the **no** form of this command.

[**no**] **debug cable-modem mac** {**log** [**verbose**] **| messages**}

Syntax Description

log	Realtime MAC log display.
verbose	(Optional) Displays periodic MAC layer events, such as ranging.
messages	MAC layer management messages.

Defaults

No default behavior or values.

Command Modes

Privileged EXEC

Command History

Release	Modification
11.3 NA	This command was introduced.

Usage Guidelines

Of all the available debug cable modem commands, the most useful is **debug cable-modem mac log**.

MAC log messages are written to a circular log file even when debugging is not turned on. These messages include timestamps, events, and information pertinent to these events. Enter the **debug cable-modem mac log** command to view MAC log messages. If you want to view this information without entering debug mode, enter the **show controllers cable-modem** *number* **mac log** command. The same information is displayed by both commands.

If the Cisco uBR900 series interface fails to come up or resets periodically, the MAC log will show what happened. For example, if an address is not obtained from the DHCP server, an error is logged, initialization starts over, and the Cisco uBR900 series scans for a downstream frequency. The **debug cable-modem mac log** command displays the log from the oldest to the newest entry.

After initial ranging is successful (dhcp_state has been reached), further `RNG-REQ/RNG-RSP` messages and watchdog timer entries are suppressed from output unless the **verbose** keyword is used. Note that `CMAC_LOG_WATCHDOG_TIMER` entries while in the maintenance_state are normal when using the **verbose** keyword.

Examples

Example 1

This example shows sample display output from the **debug cable-modem mac log** command. The fields of the output are the time since bootup, the log message, and in some cases a parameter that gives more detail about the log entry.

```
uBR924# debug cable-modem mac log
*Mar  7 01:42:59: 528302.040 CMAC_LOG_LINK_DOWN
*Mar  7 01:42:59: 528302.042 CMAC_LOG_RESET_FROM_DRIVER
*Mar  7 01:42:59: 528302.044 CMAC_LOG_STATE_CHANGE                      wait_for_link_up_state
*Mar  7 01:42:59: 528302.046 CMAC_LOG_DRIVER_INIT_IDB_SHUTDOWN          0x08098D02
*Mar  7 01:42:59: 528302.048 CMAC_LOG_LINK_DOWN
*Mar  7 01:43:05: 528308.428 CMAC_LOG_DRIVER_INIT_IDB_RESET             0x08098E5E
*Mar  7 01:43:05: 528308.432 CMAC_LOG_LINK_DOWN
*Mar  7 01:43:05: 528308.434 CMAC_LOG_LINK_UP
*Mar  7 01:43:05: 528308.436 CMAC_LOG_STATE_CHANGE                      ds_channel_scanning_state
*Mar  7 01:43:05: 528308.440 CMAC_LOG_WILL_SEARCH_DS_FREQUENCY_BAND     88/453000000/855000000/6000000
*Mar  7 01:43:05: 528308.444 CMAC_LOG_WILL_SEARCH_DS_FREQUENCY_BAND     89/93000000/105000000/6000000
*Mar  7 01:43:05: 528308.448 CMAC_LOG_WILL_SEARCH_DS_FREQUENCY_BAND     90/111250000/117250000/6000000
*Mar  7 01:43:05: 528308.452 CMAC_LOG_WILL_SEARCH_DS_FREQUENCY_BAND     91/231012500/327012500/6000000
*Mar  7 01:43:05: 528308.456 CMAC_LOG_WILL_SEARCH_DS_FREQUENCY_BAND     92/333015000/333015000/6000000
*Mar  7 01:43:05: 528308.460 CMAC_LOG_WILL_SEARCH_DS_FREQUENCY_BAND     93/339012500/399012500/6000000
*Mar  7 01:43:05: 528308.462 CMAC_LOG_WILL_SEARCH_DS_FREQUENCY_BAND     94/405000000/447000000/6000000
*Mar  7 01:43:05: 528308.466 CMAC_LOG_WILL_SEARCH_DS_FREQUENCY_BAND     95/123015000/129015000/6000000
*Mar  7 01:43:05: 528308.470 CMAC_LOG_WILL_SEARCH_DS_FREQUENCY_BAND     96/135012500/135012500/6000000
*Mar  7 01:43:05: 528308.474 CMAC_LOG_WILL_SEARCH_DS_FREQUENCY_BAND     97/141000000/171000000/6000000
*Mar  7 01:43:05: 528308.478 CMAC_LOG_WILL_SEARCH_DS_FREQUENCY_BAND     98/219000000/225000000/6000000
*Mar  7 01:43:05: 528308.482 CMAC_LOG_WILL_SEARCH_DS_FREQUENCY_BAND     99/177000000/213000000/6000000
*Mar  7 01:43:05: 528308.486 CMAC_LOG_WILL_SEARCH_SAVED_DS_FREQUENCY    663000000
*Mar  7 01:43:05: 528308.488 CMAC_LOG_WILL_SEARCH_USER_DS_FREQUENCY     663000000
*Mar  7 01:43:07: 528310.292 CMAC_LOG_DS_64QAM_LOCK_ACQUIRED            663000000
.
528383.992 CMAC_LOG_STATE_CHANGE                    registration_state
528384.044 CMAC_LOG_REG_REQ_MSG_QUEUED
528384.050 CMAC_LOG_REG_REQ_TRANSMITTED
528384.052 CMAC_LOG_REG_RSP_MSG_RCVD
528384.078 CMAC_LOG_COS_ASSIGNED_SID                1/4
528384.102 CMAC_LOG_RNG_REQ_QUEUED                  4
528384.102 CMAC_LOG_REGISTRATION_OK
528384.102 CMAC_LOG_STATE_CHANGE                    establish_privacy_state
528384.102 CMAC_LOG_STATE_CHANGE                    maintenance_state
528388.444 CMAC_LOG_RNG_REQ_TRANSMITTED
528388.444 CMAC_LOG_RNG_RSP_MSG_RCVD
528398.514 CMAC_LOG_RNG_REQ_TRANSMITTED
528398.516 CMAC_LOG_RNG_RSP_MSG_RCVD
528408.584 CMAC_LOG_RNG_REQ_TRANSMITTED
528408.586 CMAC_LOG_RNG_RSP_MSG_RCVD
528414.102 CMAC_LOG_WATCHDOG_TIMER
528418.654 CMAC_LOG_RNG_REQ_TRANSMITTED
528418.656 CMAC_LOG_RNG_RSP_MSG_RCVD
528428.726 CMAC_LOG_RNG_REQ_TRANSMITTED
528428.728 CMAC_LOG_RNG_RSP_MSG_RCVD
528438.796 CMAC_LOG_RNG_REQ_TRANSMITTED
528438.798 CMAC_LOG_RNG_RSP_MSG_RCVD
528444.102 CMAC_LOG_WATCHDOG_TIMER
528444.492 CMAC_LOG_LINK_DOWN
528444.494 CMAC_LOG_RESET_FROM_DRIVER
528444.494 CMAC_LOG_STATE_CHANGE                    wait_for_link_up_state
528444.494 CMAC_LOG_DRIVER_INIT_IDB_SHUTDOWN        0x08098D02
528444.494 CMAC_LOG_LINK_DOWN
528474.494 CMAC_LOG_WATCHDOG_TIMER
528504.494 CMAC_LOG_WATCHDOG_TIMER
528534.494 CMAC_LOG_WATCHDOG_TIMER
```

```
0 events dropped due to lack of a chunk
```

The line "`0 events dropped due to lack of a chunk`" at the end of a display indicates that no log entries were discarded due to a temporary lack of memory. This means the log is accurate and reliable.

Example 2

The following example compares the output of the **debug cable-modem mac log** command with the **debug cable-modem mac log verbose** command. The **verbose** keyword displays periodic events such as ranging.

```
uBR924# debug cable mac log
Cable Modem mac log debugging is on
uBR924#
uBR924# debug cable mac log verbose
Cable Modem mac log debugging is on (verbose)
uBR924#
574623.810 CMAC_LOG_RNG_REQ_TRANSMITTED
574623.812 CMAC_LOG_RNG_RSP_MSG_RCVD
574627.942 CMAC_LOG_WATCHDOG_TIMER
574633.880 CMAC_LOG_RNG_REQ_TRANSMITTED
574633.884 CMAC_LOG_RNG_RSP_MSG_RCVD
574643.950 CMAC_LOG_RNG_REQ_TRANSMITTED
574643.954 CMAC_LOG_RNG_RSP_MSG_RCVD
574654.022 CMAC_LOG_RNG_REQ_TRANSMITTED
574654.024 CMAC_LOG_RNG_RSP_MSG_RCVD
574657.978 CMAC_LOG_WATCHDOG_TIMER
574664.094 CMAC_LOG_RNG_REQ_TRANSMITTED
574664.096 CMAC_LOG_RNG_RSP_MSG_RCVD
574674.164 CMAC_LOG_RNG_REQ_TRANSMITTED
574674.166 CMAC_LOG_RNG_RSP_MSG_RCVD

uBR924# no debug cable mac log verbose
Cable Modem mac log debugging is off
uBR924#
574684.234 CMAC_LOG_RNG_REQ_TRANSMITTED
574684.238 CMAC_LOG_RNG_RSP_MSG_RCVD
```

Example 3

The following example shows display output for the **debug cable mac messages** command. This command causes received cable MAC management messages to be displayed in a verbose format. The messages that are displayed are shown below:

```
uBR924# debug cable-modem mac messages ?
  dynsrv   dynamic service mac messages
  map      map messages received
  reg-req  reg-req  messages transmitted
  reg-rsp  reg-rsp messages received
  rng-req  rng-req  messages transmitted
  rng-rsp  rng-rsp messages received
  sync     Sync messages received
  ucc-req  ucc-req messages received
  ucc-rsp  ucc-rsp messages transmitted
  ucd      UCD messages received
  <cr>
```

The **dynsrv** keyword displays Dynamic Service Add or Dynamic Service Delete messages during the off-hook/on-hook transitions of a phone connected to the Cisco uBR900 series.

In addition, transmitted REG-REQs are displayed in hex dump format. The output from this command is very verbose and is usually not needed for normal interface debugging. The command is most useful when attempting to attach a Cisco uBR900 series cable access router to a CMTS that is not DOCSIS-qualified.

For a description of the displayed fields of each message, refer to the DOCSIS Radio Frequency Interface Specification, v1.0 (SP-RFI-I04-980724).

```
uBR924# debug cable mac messages
*Mar  7 01:44:06:
*Mar  7 01:44:06: UCD MESSAGE
*Mar  7 01:44:06: -----------
*Mar  7 01:44:06:   FRAME HEADER
*Mar  7 01:44:06:     FC                        - 0xC2 == MAC Management
*Mar  7 01:44:06:     MAC_PARM                  - 0x00
*Mar  7 01:44:06:     LEN                       - 0xD3
*Mar  7 01:44:06:   MAC MANAGEMENT MESSAGE HEADER
*Mar  7 01:44:06:     DA                        - 01E0.2F00.0001
*Mar  7 01:44:06:     SA                        - 00E0.1EA5.BB60
*Mar  7 01:44:06:     msg LEN                   - C1
*Mar  7 01:44:06:     DSAP                      - 0
*Mar  7 01:44:06:     SSAP                      - 0
*Mar  7 01:44:06:     control                   - 03
*Mar  7 01:44:06:     version                   - 01
*Mar  7 01:44:06:     type                      - 02 == UCD
*Mar  7 01:44:06:     RSVD                      - 0
*Mar  7 01:44:06:   US Channel ID               - 1
*Mar  7 01:44:06:   Configuration Change Count  - 4
*Mar  7 01:44:06:   Mini-Slot Size              - 8
*Mar  7 01:44:06:   DS Channel ID               - 1
*Mar  7 01:44:06:   Symbol Rate                 - 8
*Mar  7 01:44:06:   Frequency                   - 20000000
*Mar  7 01:44:06:   Preamble Pattern            - CC CC CC CC CC CC CC CC CC CC CC CC CC CC 0D 0D
*Mar  7 01:44:06:   Burst Descriptor 0
*Mar  7 01:44:06:     Interval Usage Code       - 1
*Mar  7 01:44:06:     Modulation Type           - 1 == QPSK
*Mar  7 01:44:06:     Differential Encoding     - 2 == OFF
*Mar  7 01:44:06:     Preamble Length           - 64
*Mar  7 01:44:06:     Preamble Value Offset     - 56
*Mar  7 01:44:06:     FEC Error Correction      - 0
*Mar  7 01:44:06:     FEC Codeword Info Bytes   - 16
*Mar  7 01:44:06:     Scrambler Seed            - 0x0152
*Mar  7 01:44:06:     Maximum Burst Size        - 1
*Mar  7 01:44:06:     Guard Time Size           - 8
*Mar  7 01:44:06:     Last Codeword Length      - 1 == FIXED
*Mar  7 01:44:06:     Scrambler on/off          - 1 == ON
*Mar  7 01:44:06:   Burst Descriptor 1
*Mar  7 01:44:06:     Interval Usage Code       - 3
*Mar  7 01:44:06:     Modulation Type           - 1 == QPSK
*Mar  7 01:44:06:     Differential Encoding     - 2 == OFF
*Mar  7 01:44:06:     Preamble Length           - 128
*Mar  7 01:44:06:     Preamble Value Offset     - 0
*Mar  7 01:44:06:     FEC Error Correction      - 5
*Mar  7 01:44:06:     FEC Codeword Info Bytes   - 34
*Mar  7 01:44:06:     Scrambler Seed            - 0x0152
*Mar  7 01:44:06:     Maximum Burst Size        - 0
*Mar  7 01:44:06:     Guard Time Size           - 48
*Mar  7 01:44:06:     Last Codeword Length      - 1 == FIXED
*Mar  7 01:44:06:     Scrambler on/off          - 1 == ON
*Mar  7 01:44:06:   Burst Descriptor 2
*Mar  7 01:44:06:     Interval Usage Code       - 4
*Mar  7 01:44:06:     Modulation Type           - 1 == QPSK
*Mar  7 01:44:06:     Differential Encoding     - 2 == OFF
*Mar  7 01:44:06:     Preamble Length           - 128
```

```
*Mar  7 01:44:06:     Preamble Value Offset     - 0
*Mar  7 01:44:06:     FEC Error Correction      - 5
*Mar  7 01:44:06:     FEC Codeword Info Bytes   - 34
*Mar  7 01:44:06:     Scrambler Seed            - 0x0152
*Mar  7 01:44:06:     Maximum Burst Size        - 0
*Mar  7 01:44:06:     Guard Time Size           - 48
*Mar  7 01:44:06:     Last Codeword Length      - 1 == FIXED
*Mar  7 01:44:06:     Scrambler on/off          - 1 == ON
*Mar  7 01:44:06:   Burst Descriptor 3
*Mar  7 01:44:06:     Interval Usage Code       - 5
*Mar  7 01:44:06:     Modulation Type           - 1 == QPSK
*Mar  7 01:44:06:     Differential Encoding     - 2 == OFF
*Mar  7 01:44:06:     Preamble Length           - 72
*Mar  7 01:44:06:     Preamble Value Offset     - 48
*Mar  7 01:44:06:     FEC Error Correction      - 5
*Mar  7 01:44:06:     FEC Codeword Info Bytes   - 75
*Mar  7 01:44:06:     Scrambler Seed            - 0x0152
*Mar  7 01:44:06:     Maximum Burst Size        - 0
*Mar  7 01:44:06:     Guard Time Size           - 8
*Mar  7 01:44:06:     Last Codeword Length      - 1 == FIXED
*Mar  7 01:44:06:     Scrambler on/off          - 1 == ON
*Mar  7 01:44:06:
*Mar  7 01:44:06:
*Mar  7 01:44:06: MAP MESSAGE
*Mar  7 01:44:06: -----------
*Mar  7 01:44:06:   FRAME HEADER
*Mar  7 01:44:06:     FC                        - 0xC3 == MAC Management with Extended Header
*Mar  7 01:44:06:     MAC_PARM                  - 0x02
*Mar  7 01:44:06:     LEN                       - 0x42
*Mar  7 01:44:06:     EHDR                      - 0x00 0x00
*Mar  7 01:44:06:   MAC MANAGEMENT MESSAGE HEADER
*Mar  7 01:44:06:     DA                        - 01E0.2F00.0001
.
*Mar  7 01:44:17: RNG-RSP MESSAGE
*Mar  7 01:44:17: ---------------
*Mar  7 01:44:17:   FRAME HEADER
*Mar  7 01:44:17:     FC                        - 0xC2 == MAC Management
*Mar  7 01:44:17:     MAC_PARM                  - 0x00
*Mar  7 01:44:17:     LEN                       - 0x2B
*Mar  7 01:44:17:   MAC MANAGEMENT MESSAGE HEADER
*Mar  7 01:44:17:     DA                        - 00F0.1EB2.BB61
.
*Mar  7 01:44:20: REG-REQ MESSAGE
*Mar  7 01:44:20: ---------------
*Mar  7 01:44:20: C20000A5 000000E0  1EA5BB60 00F01EB2
*Mar  7 01:44:20: BB610093 00000301  06000004 03010104
*Mar  7 01:44:20: 1F010101 0204003D  09000304 001E8480
*Mar  7 01:44:20: 04010705 04000186  A0060200 0C070101
*Mar  7 01:44:20: 080300F0 1E112A01  04000000 0A020400
*Mar  7 01:44:20: 00000A03 04000002  58040400 00000105
*Mar  7 01:44:20: 04000000 01060400  00025807 04000000
*Mar  7 01:44:20: 3C2B0563 6973636F  06105E4F C908C655
*Mar  7 01:44:20: 61086FD5 5C9D756F  7B730710 434D5453
*Mar  7 01:44:20: 204D4943 202D2D2D  2D2D2D2D 0C040000
*Mar  7 01:44:20: 00000503 010100
*Mar  7 01:44:20:
*Mar  7 01:44:20:
*Mar  7 01:44:20: REG-RSP MESSAGE
*Mar  7 01:44:20: ---------------
*Mar  7 01:44:20:   FRAME HEADER
*Mar  7 01:44:20:     FC                        - 0xC2 == MAC Management
*Mar  7 01:44:20:     MAC_PARM                  - 0x00
*Mar  7 01:44:20:     LEN                       - 0x29
*Mar  7 01:44:20:   MAC MANAGEMENT MESSAGE HEADER
*Mar  7 01:44:20:     DA                        - 00F0.1EB2.BB61
```

Related Commands

Command	Description
debug cable-modem bpkm	Debugs baseline privacy information on a Cisco uBR900 series.
debug cable-modem bridge	Debugs bridge filter processing information on a Cisco uBR900 series.
debug cable-modem error	Enables debugging messages for the cable interface driver on a Cisco uBR900 series.
debug cable-modem interrupts	Debugs Cisco uBR900 series interrupts.
debug cable-modem map	Displays the timing from MAP messages to sync messages and the timing between MAP messages.

debug cable-modem map

To display the timing from MAP messages to sync messages and the timing between MAP messages on a Cisco uBR900 series cable access router, use the **debug cable-modem map** command in privileged EXEC mode. To turn the debugging messages off, use the **no** form of this command.

[**no**] **debug cable-modem map**

Syntax Description

This command has no keywords or arguments.

Defaults

No default behavior or values.

Command Modes

Privileged EXEC

Command History

Release	Modification
11.3 NA	This command was introduced.

Examples

The following example shows display output for the **debug cable-modem map** privileged EXEC command.

```
uBR924# debug cable-modem map
Cable Modem MAP debugging is on
uBR924#
*Mar  7 20:12:08: 595322.942: Min MAP to sync=72
*Mar  7 20:12:08: 595322.944: Max map to map time is 40
*Mar  7 20:12:08: 595322.982: Min MAP to sync=63
*Mar  7 20:12:08: 595323.110: Max map to map time is 41
*Mar  7 20:12:08: 595323.262: Min MAP to sync=59
*Mar  7 20:12:08: 595323.440: Max map to map time is 46
*Mar  7 20:12:09: 595323.872: Min MAP to sync=58
```

Related Commands

Command	Description
debug cable-modem bpkm	Debugs baseline privacy information on a Cisco uBR900 series.
debug cable-modem bridge	Debugs bridge filter processing information on a Cisco uBR900 series.
debug cable-modem error	Enables debugging messages for the cable interface driver on a Cisco uBR900 series.
debug cable-modem interrupts	Debugs Cisco uBR900 series interrupts.
debug cable-modem mac	Troubleshoots the Cisco uBR900 series MAC layer.

Glossary

broadband—Transmission system that combines multiple independent signals onto one cable. In the cable industry, broadband refers to the frequency-division multiplexing of many signals in a wide bandwidth of RF frequencies using a hybrid fiber-coaxial (HFC) network.

CATV—Originally stood for Community Antenna Television. Now refers to any coaxial or fiber cable-based system that provides television services.

cable modem (CM)—A modulator-demodulator device that is placed at subscriber locations to convey data communications on a cable television system. The Cisco uBR900 series cable access router is also a cable modem.

Cable Modem Termination System (CMTS)—A termination system located at the cable television system headend or distribution hub which provides complementary functionality to the cable modems, enabling data connectivity to a wide-are network.

cable router—A modular chassis-based router optimized for data-over-CATV hybrid fiber-coaxial (HFC) applications.

carrier—A signal on which another, lower-frequency signal is modulated in order to transport the lower-frequency signal to another location.

Carrier-to-Noise—C/N (also CNR). The difference in amplitude between the desired RF carrier and the noise in a portion of the spectrum.

channel—A specific frequency allocation and bandwidth. Downstream channels used for television are 6 MHz wide in the United States; 8 MHz wide in Europe.

CM—cable modem.

CMTS—Cable Modem Termination System.

coaxial cable—The principal physical media over which CATV systems are built.

CPE—Customer Premises Equipment

dB—Decibel. A measure of the relative strength of two signals.

dBm—Decibels with respect to one milliwatt. A unit of RF signal strength used in satellite work and other communications applications.

dBmV—Decibels with respect to one millivolt in a 75-ohm system. The unit of RF power used in CATV work in North America.

DHCP—Dynamic Host Configuration Protocol. This protocol provides a mechanism for allocating IP addresses dynamically so that addresses can be reused when hosts no longer need them.

DOCSIS—Data Over Cable Service Interface Specification. Defines technical specifications for equipment at both subscriber locations and cable operators' headends.

downstream—The set of frequencies used to send data from a headend to a subscriber.

FDM—Frequency Division Multiplexing. A data transmission method in which a number of transmitters share a transmission medium, each occupying a different frequency.

FEC—Forward Error Correction. In data transmission, a process by which additional data is added that is derived from the payload by an assigned algorithm. It allows the receiver to determine if certain classes of errors have occurred in transmission and, in some cases, allows other classes of errors to be corrected.

headend—Central distribution point for a CATV system. Video signals are received here from satellite (either co-located or remote), frequency converted to the appropriate channels, combined with locally originated signals, and rebroadcast onto the HFC plant. For a CATV data system, the headend is the typical place to create a link between the HFC system and any external data networks.

HFC—Hybrid fiber-coaxial (cable network). Older CATV systems were provisioned using only coaxial cable. Modern systems use fiber transport from the headend to an optical node located in the neighborhood to reduce system noise. Coaxial cable runs from the node to the subscriber. The fiber plant is generally a star configuration with all optical node fibers terminating at a headend. The coaxial cable part of the system is generally a trunk-and-branch configuration.

host—Any end-user computer system that connects to a network. In this document, the term host refers to the computer system connected to the LAN interface of the cable access router.

ingress noise—Over-the-air signals that are inadvertently coupled into the nominally closed coaxial cable distribution system. Ingress noise is difficult to track down and intermittent in nature.

MAC layer—Media Access Control sublayer. Controls access by the cable access router to the CMTS and to the upstream data slots.

MCNS—Multimedia Cable Network System Partners Ltd. A consortium of cable companies providing service to the majority of homes in the United States and Canada. This consortium has decided to drive a standard with the goal of having interoperable cable access routers.

MSO—Multiple System Operator. A cable service provider that operates in more than one geographic area, thus having multiple headend facilities.

narrowband—A single RF frequency.

NTSC—National Television Systems Committee. A United States TV technical standard, named after the organization that created the standard in 1941. Specifies a 6 MHz-wide modulated signal.

PAL—Phase Alternating Line. The TV system used in most of Europe, in which the color carrier phase definition changes in alternate scan lines. Utilizes an 8 MHz-wide modulated signal.

QAM—Quadrature Amplitude Modulation. A method of modulating digital signals onto a radio-frequency carrier signal in which the value of a symbol consisting of multiple bits is represented by amplitude and phase states of the carrier. QAM is a modulation scheme mostly used in the downstream direction (64-QAM, 256-QAM). 16-QAM is expected to be usable in the upstream direction. Numbers indicate number of code points per symbol. The QAM rate or the number of points in the QAM constellation can be computed by 2 raised to the power of <number of bits/symbol>. For example, 16-QAM has 4 bits per symbol, 64-QAM has 6 bits per symbol, and 256-QAM has 8 bits per symbol.

QPSK—Quadrature Phase-Shift Keying. A digital modulation method in which there are 2 data bits represented with each baud symbol.

ranging—The process of acquiring the correct timing offset such that the transmissions of a cable access router are aligned with the correct mini-slot boundary.

RF—Radio frequency. The portion of the electromagnetic frequency spectrum from 5 MHz to approximately 860 MHz.

SECAM—TV system used in France and elsewhere, utilizing an 8 MHz-wide modulated signal.

SID (Service ID)—A number that defines (at the MAC sublayer) a particular mapping between a cable access router (CM) and the CMTS. The SID is used for the purpose of upstream bandwidth allocation and class-of-service management.

Signal-to-Noise—S/N (also SNR). The difference in amplitude between a baseband signal and the noise in a portion of the spectrum.

spectrum reuse—CATV's most fundamental concept. Historically, the over-the-air spectrum has been assigned to many purposes other than that of carrying TV signals. This has resulted in an inadequate supply of spectrum to serve the needs of viewers. Cable can reuse spectrum that is sealed in its aluminum tubes.

subscriber unit (SU)—An alternate term for cable access router. See *cable access router.*

upstream—The set of frequencies used to send data from a subscriber to the headend.